

Arnold Irrigation District Infrastructure Modernization Project

Draft Watershed Plan-Environmental Assessment

Deschutes County, Oregon

June 8, 2021



United States Department of Agriculture, Natural Resources Conservation Service – Lead Federal Agency in cooperation with the Deschutes Basin Board of Control and Arnold Irrigation District

Prepared by Farmers Conservation Alliance

Watershed Plan-Environmental Assessment for the Arnold Irrigation District - Infrastructure Modernization Project

Lead Agency: United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Oregon

Sponsoring Local Organization: Deschutes Basin Board of Control (DBBC) (lead sponsor) and Arnold Irrigation District (AID) (co-sponsor).

Authority: This Watershed Plan-Environmental Assessment (Plan-EA) has been prepared under the Authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law [PL] 83-566). The Plan-EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, PL 91-190, as amended (42 United States Code [U.S.C.] 43221 et seq.).

Abstract: This document is intended to fulfill requirements of the NEPA and to be considered for authorization of PL 83-566 funding of the Arnold Irrigation District Infrastructure-Modernization Project (project). The project seeks to improve water conservation, water delivery reliability, and public safety for irrigation infrastructure in Oregon's Deschutes Basin. The project would include piping approximately 13.2 miles of AID's Main Canal. Total estimated project costs are \$42,759,000 of which \$14,897,000 would be paid by the sponsors and other non-federal funding sources. The estimated amount to be paid through NRCS PL 83-566 funds is \$27,862,000.

Comments: Comments must be submitted during the allotted Draft Public Review Period (within 30 days of the public release of the Draft Plan-EA) and become part of the Administrative Record. Submit comments and inquiries to: Farmers Conservation Alliance, Attention Watershed Plan-EA, 102 State Street, Hood River, OR 97031, or arnold.id.comments@gmail.com.

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Office of Management and Budget Fact Sheet

Summary Watershed Plan-Environmental Assessment Document For Arnold Irrigation District Infrastructure Modernization Project Upper Deschutes Basin Subwatersheds: Lava Island Falls-Deschutes River, Overturf Butte-Deschutes River, Deschutes Junction, and Odin Falls-Deschutes River Deschutes County, Oregon Oregon 2nd Congressional District	
Authorization	PL 83-566 Stat. 666 as amended (16 U.S.C. Section 1001 et. Seq.) 1954
Lead Sponsor	Deschutes Basin Board of Control and Arnold Irrigation District (co-sponsor)
Proposed Action	<p>The Arnold Irrigation District (AID or the District) Infrastructure Modernization Project is an agricultural water conveyance efficiency project. The proposed action would pipe 13.2 miles of Arnold Irrigation District's Main Canal owned and operated by the District.</p> <p>Implementation of the proposed action would meet PL 83-566 Authorized Project Purpose (v), Agricultural Water Management, through irrigation water conservation and more reliable agricultural water supply.</p> <p>Federal assistance through PL 83-566 would support the District in addressing the following watershed problems and resource concerns: water loss in District infrastructure; water delivery and operations inefficiencies; instream flow for fish and aquatic species; and risks to public safety from open irrigation canals.</p> <p>Implementation of the proposed action would address the sponsor's objectives and goals to reduce seepage loss and provide better-managed water diversions for farm use; support agricultural land use; improve streamflow for fish, aquatic, and riparian habitat; and increase public safety.</p>
Purpose and Need	<p>The purpose of this project is to improve water conservation in District-owned infrastructure, improve water supply management and delivery reliability to District patrons, and improve public safety on up to 13.2 miles of the District-owned Main Canal.</p> <p>Federal assistance is needed to support the District in addressing water loss in District infrastructure, District water delivery and operation inefficiencies, diminished instream flows that limit fish and aquatic habitat, and public safety risk caused by open canals.</p>
Description of the Preferred Alternative	Under the Preferred Alternative, AID would pipe 13.2 miles of the Main Canal.
Project Measures	Under the Preferred Alternative, project sponsors would install 13.2 miles of pipe ranging in size from 48 to 63 inches in diameter. Additionally, 88 turnouts would be upgraded to pressurized delivery systems. Below the District's diversion, an elevated pipe would replace the first 450 feet of the existing, elevated flume. The pipe would be buried along the rest of the flume and Main Canal. Construction of the Preferred Alternative would occur over 7 years.

Resource Information			
Subwatersheds	12-digit Hydrologic Unit Code	Latitude and Longitude	Subwatershed Size
Lava Island Falls-Deschutes River	170703010405	43.99453392, -121.4567205	12,518 acres
Overturf Butte – Deschutes River	170703010406	43.98818452, -121.359427	31,374 acres
Deschutes Junction	170703010801	44.07052471, -121.268003	47,339 acres
Odin Fall - Deschutes	170703010805	44.1377907, -121.2207872	66,358 acres
Subwatershed Total Size	157,582 acres		
Arnold Irrigation District Size	20,799 acres		
Climate and Topography	The project is located in the rain shadow of the Cascade Mountain range. AID’s annual average precipitation is 12 to 15 inches. The average high temperature for July is 85 degrees Fahrenheit, and average low temperature for December is 26 degrees Fahrenheit. The land within AID is slightly undulating. The Arnold Canal Diversion is at 3,925 feet above sea level. There is approximately 60 feet of elevation loss between the diversion and the end of the Main Canal.		
Land Use (Planning Area)	Use	Acres	
	Irrigated Land	1,475	
	Non-irrigated Land	300	
Land Ownership (Planning Area)	Owner	Percentage	
	Private	99.2%	
	State-Local	0.2%	
	Federal	0.6%	
Population and Demographics	The project would be constructed in Deschutes County, Oregon. In 2015, the population of Deschutes County was 166,622. The population growth rate between 2000 and 2015 was 14 percent. The population of the State of Oregon grew by 8 percent in the same period.		
Population and Demographics		Deschutes County	Oregon
	Population 2015	166,622	3,939,233
	Unemployment Rate	4.1%	4.1%
	Median Household Income	\$51,223	\$51,243
Relevant Resource Concerns	Resource concerns identified through scoping were water conservation and quality, groundwater, aquatic and fish resources, soils, land use, visual resources, cultural resources, socioeconomics, wetlands, terrestrial wildlife, public safety, and vegetation resources.		

Alternatives						
Alternatives Considered	Eight alternatives were initially considered; six were eliminated from full analysis because they did not address the purpose and need for action, did not achieve the Federal Objective and Guiding Principles, or because they became unreasonable due to cost, logistics, existing technology, social, or environmental reasons. The No Action Alternative and Piping Alternative were analyzed in full.					
No Action Alternative (Future without Federal Investment)	Under the No Action Alternative, construction activities associated with the project would not occur and AID would continue to operate and maintain its existing system in its current condition. The need for the project would still exist; however, the District would only modernize its infrastructure on a project-by-project basis as funding became available. This funding is not reasonably certain to be available under a project-by-project approach at the large scale necessary to modernize the District's infrastructure.					
Proposed Action (Future with Federal Investment)	Under the Piping Alternative, AID would pipe 13.2 miles of the Main Canal. The Piping Alternative has been identified as the National Economic Efficiency (NEE) plan and is the Preferred Alternative.					
Mitigation, Minimization, and Avoidance Measures	<p>Consultation between the District, NRCS as the lead federal agency, Tribal Historic Preservation Office (THPO), Oregon State Historic Preservation Office (SHPO), and consulting parties including affiliated tribes for compliance with Section 106 of the National Historic Preservation Act (NHPA) would occur prior to project implementation.</p> <p>Ground disturbances would be limited to only those areas necessary to minimize effects on soil, vegetation, and land use. Where possible, construction activities would avoid or minimize effects on agricultural lands by staying within the existing right-of-way and easements. Stormwater best management practices (BMPs) would be employed during and after construction, and construction schedules would minimize disturbance to wildlife and the public. After construction, disturbed areas would be graded and replanted with a mix of native grasses and forbs to reduce the risk of erosion and spread of noxious weeds.</p> <p>Following project implementation, the District's conveyance system would be more efficient and by enacting similar practices to that of the District's current and historic use of water, AID would divert only the volume of water needed by patrons. Therefore, AID would decrease their diversion rate accordingly, leaving any water that the District does not divert in the Deschutes River available for use by junior water right holders. Additionally, to reduce effects on junior water right holders, AID would voluntarily reduce their maximum diversion rate and identify 120 cubic feet per second (cfs) as the District's pre-project maximum diversion rate for the purposes of any water right administrative processes.</p>					
Project costs	PL 83-566 funds		Other funds		Total	
Construction	\$24,900,000	65%	\$13,451,000	35%	\$38,351,000	100%
Engineering	\$430,000	75%	\$143,000	25%	\$573,000	100%
SUBTOTAL COSTS	\$25,330,000	65%	\$13,594,000	35%	\$38,924,000	100%
Technical Assistance	\$2,025,000	100%	\$0	0%	\$2,025,000	100%
Relocation	Not Applicable					

Real Property Rights	Not Applicable					
Permitting	\$0	0%	\$1,168,000	100%	\$1,168,000	100%
Project Administration	\$507,000	79%	\$135,000	21%	\$642,000	100%
Annual O&M	Not Applicable					
TOTAL COSTS	\$27,862,000	65%	\$14,897,000	35%	\$42,759,000	100%
Project Benefits						
Project Benefits	Implementation of the Preferred Alternative would improve water delivery reliability for AID's patrons; save an estimated 32.5 cfs of water (10,526 acre-feet) from seepage loss during the irrigation season; provide up to 10,123 acre-feet of water to North Unit Irrigation District (NUID); release and protect an estimated 10,123 acre-feet for instream uses below Wickiup Reservoir during the non-irrigation season; reduce AID's operation and maintenance (O&M) costs; and improve public safety.					
Number of Direct Beneficiaries	In total, 149 patrons would directly benefit from the project.					
Other Beneficial Effects-Physical Terms	The Preferred Alternative would have beneficial effects on agricultural water availability, water quality, and fish and wildlife habitat.					
Damage Reduction Benefits			Proposed Project			
Reduced North Unit Irrigation District Agricultural Damage			\$1,489,000			
Other- Reduced Operation and Maintenance			\$210,000			
Other-Avoided Damage from Infrastructure Failure			\$17,000			
Other- Pumping Cost Savings			\$4,000			
Other- Instream Value			\$42,000			
Other- Oregon Spotted Frog Support			\$39,000			
Total Quantified Benefits			\$1,801,000			
Benefit to Cost Ratio			1.82			

Period of Analysis			
Installation Period (years)	7		
Project Life	100 years		
Funding Schedule			
Year	PL 83-566	Other Funds	Total
2022-2029	\$27,862,000	\$14,897,000	\$42,759,000
Environmental Effects			
<p>The Preferred Alternative would be planned, designed, and installed to have long-term net-beneficial effects on water quantity, water quality, Endangered Species Act (ESA)-listed species and their habitats, and other aquatic species that have similar environmental requirements. Other long-term net-beneficial effects would include improving ecosystem services and public safety.</p> <p>Implementation of the Preferred Alternative to improve water conservation, water delivery reliability, and public safety may result in minor, unavoidable, short-term adverse effects such as impacts to soils and vegetation along the Main Canal. Most short-term adverse effects would result from construction activities in the project area.</p> <p>There would be long-term minor adverse effects on artificial wetland habitat within the project area. Opportunistic hydrophytic vegetation growing along 12.2 miles¹ of canal would be permanently removed. However, following construction, BMPs for ecological restoration would be followed and there would be an increase in native, upland vegetation in the project area, returning the project area to a more natural state. Loss of existing artificial wetland and riparian habitat would be offset by enhancement of naturally functioning wetland and riparian habitat in the Deschutes River.</p> <p>Other long-term minor effects include potential changes in wildlife distribution patterns and alterations to the visual landscape following elimination of 13.2 miles of the open Main Canal and flume. Construction would occur outside the primary nesting period for migratory birds of concern. Should an active nest be found, construction would be paused and consultation with a local U.S. Fish and Wildlife Service (USFWS) biologist would occur. After construction, disturbed areas above buried pipelines would be revegetated and recontoured to blend in with the existing landscape. For the flume, the new elevated pipe would have a similar design and contrast to the landscape as the existing flume.</p>			
Major Conclusions	Implementation of the Preferred Alternative would improve water delivery reliability for AID's patrons, save an estimated 10,526 acre-feet of water from seepage loss, provide up to 10,123 acre-feet to NUID, release and protect up to 10,123 acre-feet below Wickiup Reservoir for instream uses during the non-irrigation season, reduce AID's O&M costs, and improve public safety.		
Areas of Controversy	There have been no areas of controversy identified.		
Issues to be Resolved	None		

¹ The project length is 13.2 miles and includes an existing 1-mile long flume. Therefore, opportunistic hydrophytic vegetation would be permanently removed along 12.2 miles.

Evidence of Unusual Congressional or Local Interest	Comments during the scoping period were received from the USFWS and local non-governmental organizations and individuals.
Compliance	Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes <u> X </u> No _____

1 Introduction

Aging infrastructure, growing populations, shifting rural economies, and changing climate conditions have increased pressure on water resources across the western United States. Within the Deschutes Basin, irrigated agriculture is the main out-of-stream water use and relies on primarily 100-year-old infrastructure to divert, store, and deliver water to farms and ranches. In recent years, the improvement of water resources has been a coordinated focus among the eight irrigation districts within the Deschutes Basin, with the goal of addressing environmental needs for instream flows while still delivering enough water to district patrons (Figure 1-1).

Arnold Irrigation District (herein referred to as AID or the District) operates 39 miles of canals and laterals in the Deschutes Basin. Most of this infrastructure consists of open, earthen canals. Approximately 45 percent of the water diverted into AID's Main Canal seeps into the porous, volcanic geology or evaporates prior to reaching District patrons.

Over the years, AID has pursued infrastructure upgrades to provide a permanent solution to system-wide water losses. Although some improvements have been made, aging and outdated infrastructure continues to contribute to water delivery insecurity for out-of-stream users and limit streamflow due to the need to divert more water than is delivered, affecting water quality and aquatic habitat along the Deschutes River. The Main Canal has become a public safety risk to more people as the surrounding areas have urbanized. Aging infrastructure also affects the financial stability of AID and its patrons, as the District must find new approaches to fund growing maintenance needs.

Improving irrigation infrastructure offers an opportunity to conserve water, increase reliability of water delivery to patrons, enhance streamflow and habitat conditions for fish and aquatic species in the Deschutes Basin, reduce risks to public safety from open irrigation canals, and reduce operation and maintenance (O&M) costs for the District.

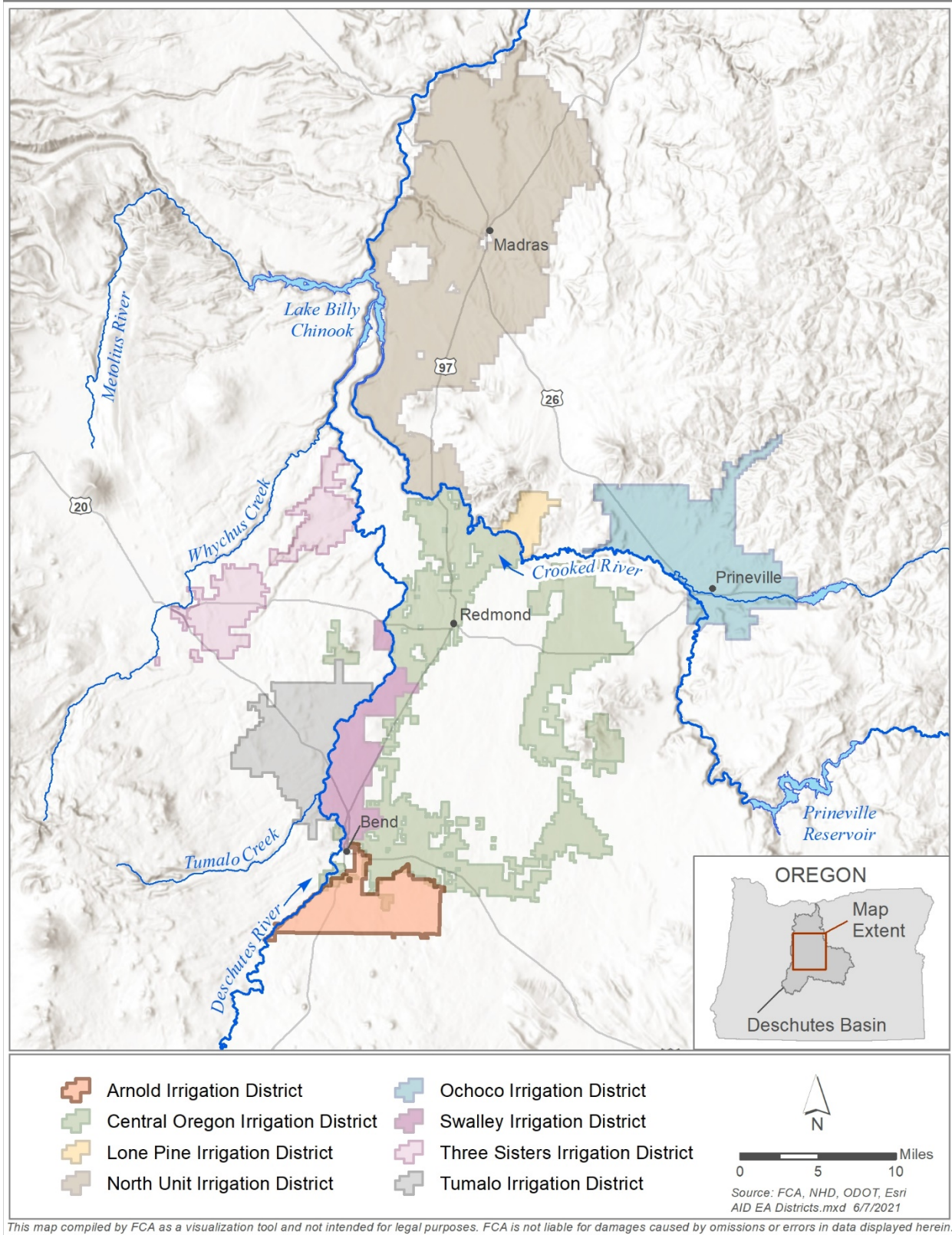


Figure 1-1. Irrigation districts within the Deschutes Basin.

1.1 Planning Area

The District is located south of Bend in Deschutes County, Oregon. The District contains 4,384 irrigated acres used by 646 patrons. The main point of diversion is on the Deschutes River (River Mile [RM] 174.5). The planning area is based on the irrigation problem area² and is identified as the tax lots traversed by the proposed project (Table 1-1, Figure 1-2).

Table 1-1. Arnold Irrigation District Planning Area.

Subwatershed Name	12-Digit Hydrologic Unit Code	Subwatershed Size (acres)	Planning Area Falling within the Subwatersheds (acres)
Lava Island Falls – Deschutes River	170703010405	12,518	114
Overturf Butte – Deschutes River	170703010406	31,374	172
Deschutes Junction	170703010801	47,339	857
Odin Falls – Deschutes River	170703010805	66,358	613
Total		157,589	1,756

² The “planning area” referred to in this Plan-EA is equivalent to the term “watershed area” as defined by the National Watershed Program Manual (NWPM) 506.60.TTT (NRCS 2015a). The term “planning area” is used in this Plan-EA in an effort to reduce confusion between the NWPM 506.60.TTT watershed area definition and watershed areas as defined by hydrologic unit codes.

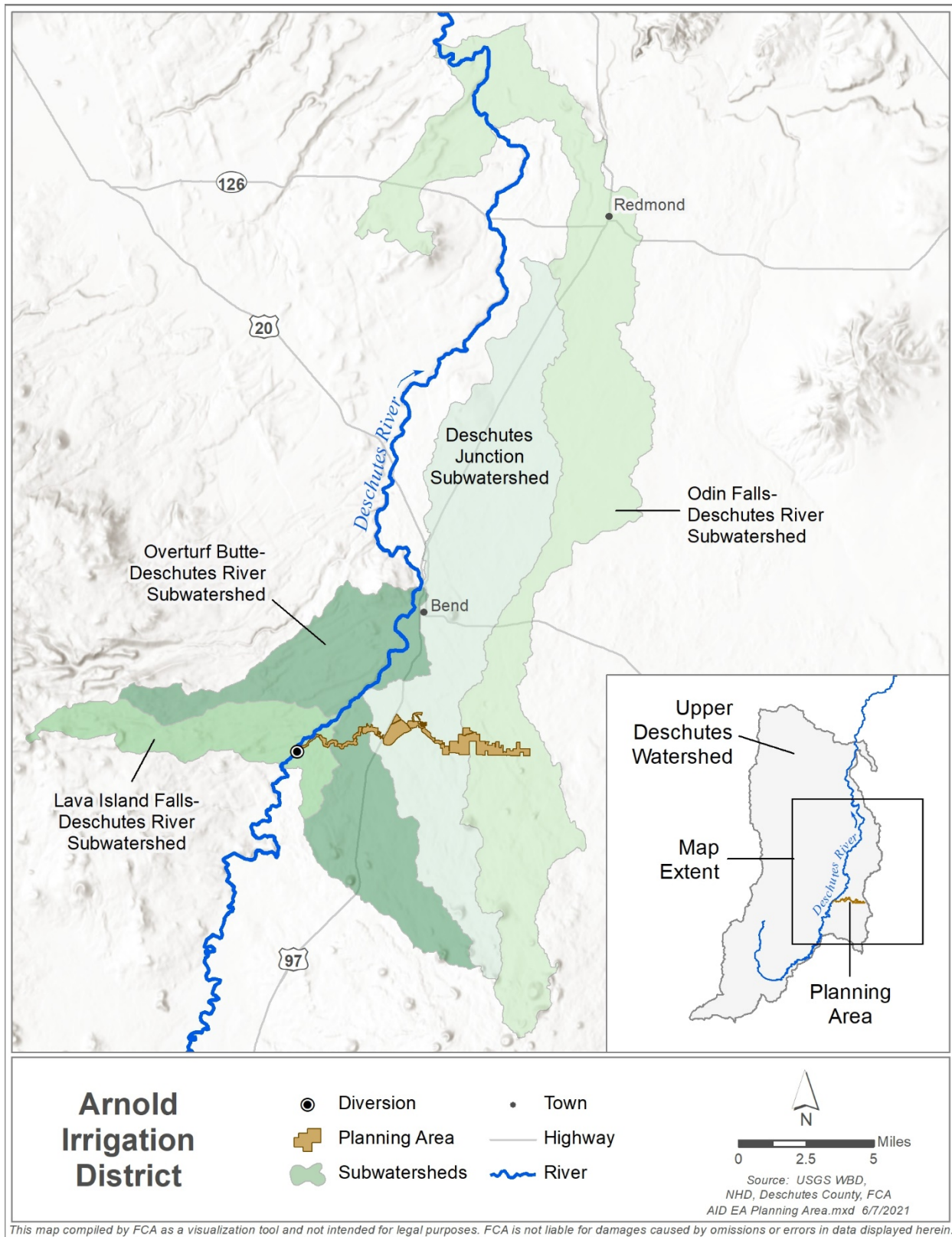


Figure 1-2. The Arnold Irrigation District planning area.

1.2 Project Area

The project area is located in a portion of the planning area. The project area describes where the AID Infrastructure Modernization Project would occur (Figure 1-3). The proposed project includes 13.2 miles of the Main Canal (12.2 miles of open canal and 1 mile of open flume), which is only a portion of the District's total conveyance system. The project area consists of the District's rights-of-way (ROWs) and easements that contain these 13.2 miles of the Main Canal. The water conveyance infrastructure in the project area consists of earthen dug canal, two siphons, and an aerial flume.

1.3 Current Infrastructure

The District diverts water from the Deschutes River at the Arnold Canal Diversion on the Deschutes River (RM 174.5). The diversion has a radial gate that regulates the intake flow rate and a vertical flat-plate fish screen that keeps fish and debris out of the District's conveyance system. Oregon Water Resources Department's (OWRD) gauge number 14065500 measures inflows into the conveyance system; the District is in the process of adding remote measurement and control systems just below its fish screen. The Main Canal conveys water generally northeast, starting with an approximately 1-mile-long flume and trestle system and then transitioning to a typical earthen and rock substrate open canal. After the flume, the Main Canal runs approximately 12.2 miles from west to east. Along the way, it delivers directly to patrons and to multiple laterals.

AID has already piped approximately 22 percent of its system, primarily laterals that are not part of the project area. Patron turnouts from the Main Canal are gate-regulated and weir-measured by AID field staff. An additional six private direct withdrawals from the Deschutes River irrigate 30 acres of the District.

The Main Canal loses up to an estimated 32.5 cubic feet per second (cfs) of water during the irrigation season (10,526 acre-feet annually) due to a combination of seepage related to the condition of the distribution system and porous nature of the underlying geology, and evaporation. Water loss associated with specific sections of the Main Canal is detailed in the District's System Improvement Plan (SIP; Crew 2017; also see Appendix E.4).

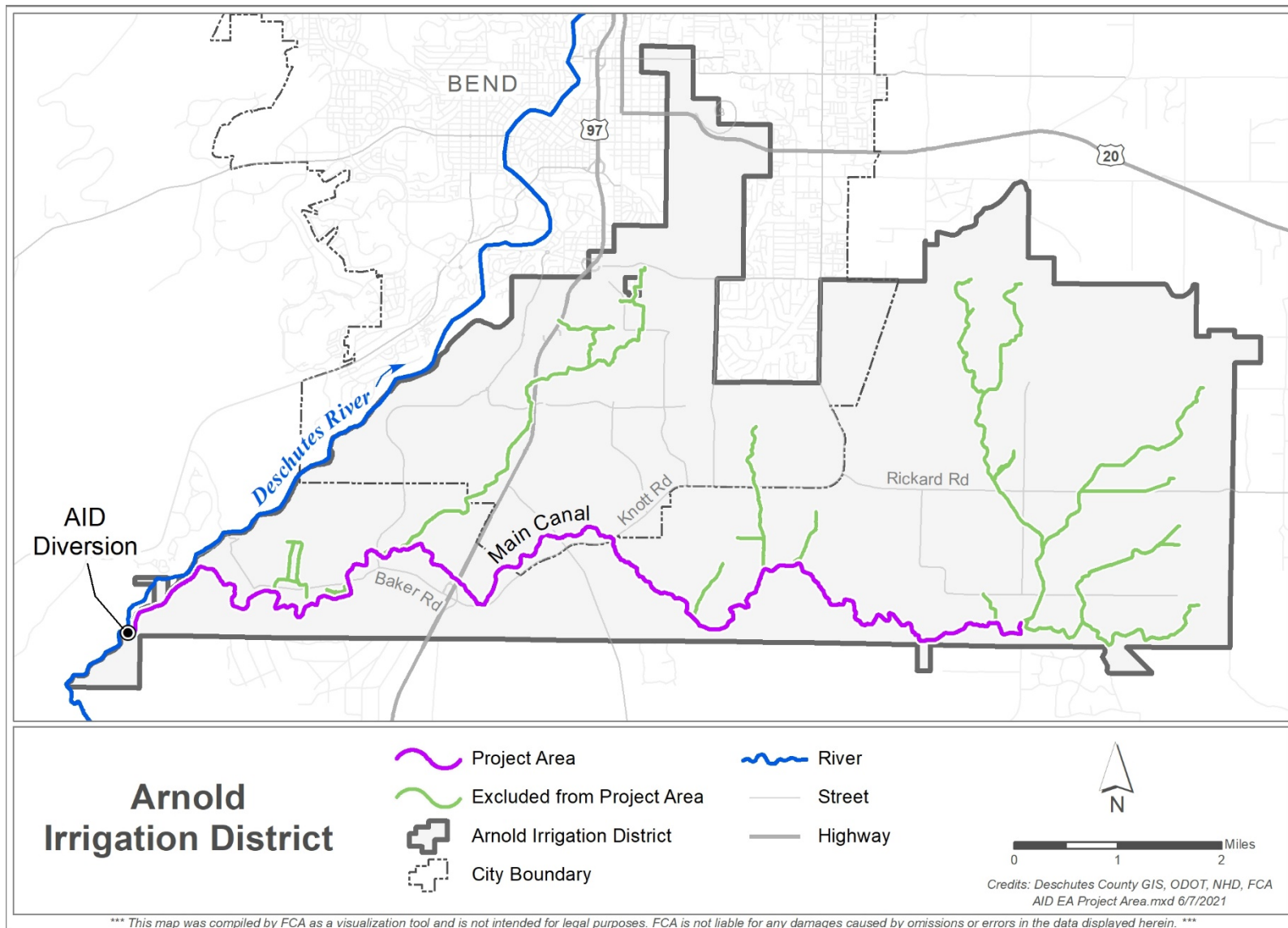


Figure 1-3. Arnold Irrigation District's Infrastructure Modernization Project Area.

1.4 Decision Framework

This Draft Watershed Plan-Environmental Assessment (Plan-EA) has been prepared to assess and disclose the potential effects of the proposed action. This Plan-EA is required to request federal funding through the Watershed Protection and Flood Prevention Program, Public Law (PL) 83-566, authorized by Congress in 1954 (herein referred to as PL 83-566).

Natural Resources Conservation Service (NRCS) is the lead federal agency for this Plan-EA and is responsible for review and issuance of a decision in accordance with the National Environmental Policy Act (NEPA). NEPA requires that Environmental Impact Statements (EISs) are completed for projects utilizing federal funds that significantly affect the quality of the human environment and natural environment (individually or cumulatively). When a proposed project is not likely to result in significant impacts requiring an EIS, but the activity has not been categorically excluded from NEPA, an agency can prepare an Environmental Assessment (EA) to assist them in determining whether an EIS is needed (see 40 Code of Federal Regulations [CFR] 1501.4, 1508.9; 7 CFR 650.8). For purposes of NEPA compliance, the intent of this Plan-EA is to determine if the project, as proposed, significantly affects the quality of the human and natural environment.

This Plan-EA follows a tiering approach to NEPA. Tiering is a staged approach to NEPA as described in the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 to 1508). Broad programs and issues are described in initial analyses, while site-specific proposals and impacts are described in subsequent site-specific studies. The tiered process permits the lead agency to focus on issues that are ripe for decision and exclude from consideration issues already decided or not yet ready for decision. Tiering eliminates repetitive discussions of the same issues across site-specific areas through incorporation by reference the general discussions.

NRCS has determined the need for a Plan-EA to analyze the effects of the proposed action under PL 83-566 watershed authority. Due to the multi-year phasing, this Plan-EA does not identify the specific details associated with the engineering design and construction activities that would be required to implement the proposed action. Instead, this document intends to present an analysis in sufficient detail to allow implementation of a proposed action within the designated project area. If the analysis demonstrates that the project does not significantly affect the quality of the human environment, minimal additional NEPA analysis would be required.

The proposed action would be completed in one project group over the course of 7 years. Consistent with the tiering process as described above, prior to the implementation of each site-specific project, an onsite Environmental Evaluation (EE) review would occur utilizing the form NRCS-CPA-52, Environmental Evaluation Worksheet. The EE process would determine if that particular individual project meets applicable project specifications, and whether the site-specific environmental effects are consistent with those as described and developed in this Plan-EA. This process provides information for the Responsible Federal Official to determine if the proposed action has been adequately analyzed, and if the conditions and environmental effects described in the Plan-EA are still valid. Where the impacts of the narrower project-specific action are identified and analyzed in the Plan-EA, no further analysis would occur, and the Plan-EA would be used for purposes of the pending action.

If it is determined based on the findings of the EE that the Plan-EA is not sufficiently comprehensive, not adequate to support further decisions, or if resource concerns or effects have not been adequately evaluated through the programmatic approach, a separate site-specific supplemental EA would be prepared.

This Plan-EA has been prepared to meet NEPA requirements³ as well as program and environmental review requirements specific to NRCS federal investments in water resources projects.⁴ Some considerations and analyses in the Plan-EA are strictly NRCS program requirements; they are not required by NEPA. These differences are identified throughout this Plan-EA.

³ The Plan-EA process began prior to the updated NEPA CEQ regulations that went into effect September 14, 2020. This plan is, therefore, prepared in accordance with the CEQ regulations that were in place when planning began as provided for in the 2020 CEQ NEPA regulations at 43 CFR 1507.3. All references to NEPA CEQ regulations, therefore, correspond to the 1978 regulations and the existing agency NEPA procedures that were in place prior to the 2020 update. The Plan-EA has also been prepared in accordance with NEPA (40 CFR 1500–1508), USDA’s NEPA regulations (7 CFR Part 650), NRCS Title 190 General Manual Part 410, and the NRCS National Environmental Compliance Handbook Title 190 Part 610 (May 2016).

⁴ The Plan-EA has been prepared in accordance with the guidelines in the 2015 NRCS NWPM (NRCS 2015a), and the 2014 NRCS National Watershed Program Handbook (NRCS 2014). It has also been prepared in accordance with the Principles and Requirements (P&R) issued in March 2013 along with Interagency Guidelines, and Agency Specific Procedures established in DM9500-013. These documents comprise the Principles, Requirements and Guidelines (PR&G; NRCS 2017). The PR&G revise and replace the 1983 Principles and Guidelines. The PR&G constitute the comprehensive policy and guidance for federal investments in water resources.

2 Purpose and Need for Action

The purpose of this project is to improve water conservation in District-owned infrastructure, improve water supply management and delivery reliability to District patrons, and improve public safety on up to 13.2 miles of the District-owned Main Canal.

Federal assistance is needed to support the District in addressing water loss in District infrastructure, water delivery and operation inefficiencies, diminished instream flows that limit fish and aquatic habitat, and public safety risk caused by open canals. These topics are discussed in Section 2.1.

To meet NRCS requirements for a federal investment in a water resources project, the project must meet the Federal Objective set forth in the Water Resources Development Act of 2007, promote the Federal Objective and Guiding Principles (as identified in the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments [PR&G; NRCS 2017]), and be an authorized project purpose under Sections 3 and 4 of PL 83-566.

Per the Federal Objective, water resource investments—including the proposed action—put forth in this Plan-EA should: “reflect national priorities, encourage economic development, and protect the environment by: (1) seeking to maximize sustainable economic development; (2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems” (NRCS 2013). Additionally, the project should seek to achieve the following Guiding Principles as identified by the Federal Government: Healthy and Resilient Ecosystems, Sustainable Economic Development, Floodplains, Public Safety, Environmental Justice, and Watershed Approach (NRCS 2017).

The proposed project would be eligible for funding under PL 83-566 requirements as an “Authorized Project Purpose (v), Agricultural Water Management,”⁵ through irrigation water conservation, water quality improvement, and more reliable agricultural water supply.

2.1 Watershed Problems and Resource Concerns

2.1.1 Water Loss in District Conveyance Systems

Currently, during the irrigation season, AID’s Main Canal loses up to approximately 32.5 cfs of water (10,526 acre-feet annually⁶) to seepage through the porous underlying geology and evaporation. This water never reaches farms. Details on water losses and demands are in Appendix E.4 of this Plan-EA and the District’s SIP (Crew 2017).

⁵ A description of Authorized Purposes can be found in 390-NWPM, Part 500, Subpart A, Section 500.3B (NRCS 2015a).

⁶ These water loss values reflect water lost in the 12.2-mile-long, earthen section of the Main Canal. Water loss in the 1-mile-long flume has not been measured and is therefore not included in total water loss values. Due to the flume’s close proximity to the Deschutes River, water lost from the flume likely returns to the river.

2.1.2 Water Delivery and Operations Inefficiencies

Over the years, the District has developed rigorous measurement and management methods that have greatly increased District efficiency; however, high seepage loss rates make it challenging to deliver the patrons' desired delivery rate throughout the irrigation season and cause delivery shortages during the peak season (May 15 through September 14).

The District's earthen Main Canal experiences failure from sinkholes, tree roots, and burrowing animals. The District's aerial flume is difficult and expensive to maintain and is at risk from wildfire damage. To repair the canal or flume, AID must stop the delivery of irrigation water, often at times for multiple days. In the current open canal system, all patrons are required to request changes to water deliveries 24 to 36 hours in advance. Changes to water deliveries in this manner are inefficient and unresponsive to immediate need and may affect deliveries to other patrons.

Operating and maintaining the Main Canal also requires staff to clean the canal, adjust flows to patrons, clean debris from trash racks, repair sinkholes, and replace sections of flume. Overall, the Main Canal does not transport and deliver water as precisely, accurately, or efficiently as a modernized system would.

2.1.3 Instream Flow for Fish and Aquatic Habitat

Compared to the natural hydrologic regime, the Deschutes River and its tributaries experience extreme streamflow variability seasonally due to the storage and diversion of water for agricultural use. Resource agencies have identified streamflow as a primary concern in the Deschutes River (UDWC 2014). Reservoir operations lead to low winter streamflow and high summer streamflow in the Deschutes River upstream from AID's diversion. The combined diversions of the seven major irrigation districts and the cities that divert water in or near Bend lead to low spring, summer, and fall streamflow in the Deschutes River, downstream of AID's diversion.

The Deschutes River and its tributaries support a variety of sensitive species, of which three are currently listed as threatened under the Endangered Species Act (ESA) (Section 4.9.2). Major efforts have been made to support these species and their habitats; however, lawful irrigation-related activities continue to limit streamflow, negatively affecting fish and aquatic habitat.

Current irrigation activities have the potential to result in incidental "take"⁷ of ESA-listed species in the Deschutes River and its tributaries. The eight irrigation districts of the Deschutes Basin and the City of Prineville (the applicants) have together developed and submitted the Deschutes Basin Habitat Conservation Plan (HCP; AID et al. 2020) to the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), which includes irrigation activity conservation measures. The conservation measures include streamflow targets in the Deschutes River and its tributaries that the applicants must meet to benefit the ESA-listed species. USFWS and NMFS provided a final permit decision on December 31, 2020, which adopts the HCP and enables the applicants to avoid the unauthorized take of ESA-listed species by issuing incidental take permits.

⁷ ESA defines "take" to include actions such as the harassment, harm, pursuit, hunting, shooting, wounding, killing, trapping, capture, collection, or attempts to engage in any such conduct of ESA-listed species.

To meet the requirements set forth in the HCP, the applicants must identify mechanisms that would enable them to keep water instream.

Additionally, the Deschutes River is listed as an impaired waterway under Section 303(d) of the Clean Water Act (CWA) because it does not meet one or more of the State of Oregon's water quality standards for salmon and trout, as well as other beneficial uses throughout the year (see Section 4.8).

2.1.4 Risks to Public Safety

The open Main Canal poses a risk to public safety. In addition to multiple instances of injury in AID, at least 10 deaths have occurred in other irrigation district canals near AID (“19-year old Redmond woman died” 2014; KTVZ 2014; Chu 2004; Cliff 2008; Flowers 2004; Golden 2007; Minoura 2007). The District's location in a partly urbanized area heightens the potential for an accident, as the Main Canal passes through urban areas, rural residences, private lands, and irrigated fields.

During the summer, water depths in the Main Canal range between 2 to 6 feet, with velocities up to 5 cfs. These conditions make it difficult for a healthy, strong adult to stand in or climb out of the canal without assistance. A child or non/weak-swimmer would have an even higher risk of drowning in a canal with these attributes. If a person or animal falls into a canal, they could have serious difficulty gaining hold on the banks to climb out due to the volume and speed of the moving water. Currently, barriers or fences are not present at the top bank of the canal. The failure of the earthen canal and risk of localized flooding is also a concern for the District. The District experiences sinkholes on a regular basis including a most recent one in May 2021.

In 2015, Deschutes County was the fastest growing county in Oregon, based on the Oregon Population Report (PSU 2015). Public safety risks associated with the open canal will continue to grow as the county's population grows.

2.2 Watershed and Resource Opportunities

The following resource opportunities would be realized through the implementation of the project.

- Improve streamflow, water quality, habitat, and habitat availability in the Deschutes River downstream from Wickiup Reservoir by protecting 100 percent of the water saved instream during the non-irrigation season;
- Support and maintain existing agriculture through enhanced water supply reliability and improved water management;
- Minimize the potential for flooding, injury, and loss of life associated with the open AID Main Canal; and
- Reduce the District's O&M involved in delivering irrigation water to AID patrons.

3 Scope of the Plan-EA

3.1 Agency, Tribal, and Public Outreach

Federal, state, and local agencies and representatives, as well as non-governmental organizations, received an invitation to participate in scoping this Plan-EA. Advertisements announcing the scoping period and associated scoping meeting were placed in a local newspaper in addition to multiple online locations including NRCS’s website, the District’s website, and the DBBC’s website (see Section 7). Additionally, the District notified patrons of the scoping meeting and invited comments on the scope of this Draft Plan-EA.

NRCS conducted tribal consultation with the Tribal Historic Preservation Office (THPO) in accordance with the National Historic Preservation Act (NHPA) of 1966 and Executive Order (EO) 13175, *Consultation and Coordination with Indian Tribal Governments*, to maintain NRCS’s government-to-government relationship between Native villages and tribes. NRCS sent a letter to the Confederated Tribes of Warm Springs (CTWS) requesting input and notifying them of the scoping process. CTWS responded and requested that they be consulted during the planning phase of the project.

3.2 Scoping Meeting

A scoping meeting was held on April 17, 2019, at Elk Meadow Elementary School in Bend. Presenters at the meeting included Tom Makowski, NRCS; Shawn Gerdes, AID; Raija Bushnell, Farmers Conservation Alliance (FCA); and Margi Hoffmann, FCA. The presentations covered the financial assistance available through PL 83-566, the project purpose and need, the Plan-EA process, and ways in which the public could get involved. After the presentations, attendees asked questions and provided comments for the public record. One hundred and twenty people attended the meeting, excluding staff from AID, NRCS, and FCA.

3.3 Scoping Comments

Scoping comments were accepted from April 3 to May 15, 2019. Comments were submitted at the public meeting on April 17, 2019, and by email, online comment, mail, and phone.

Comments generally supported the project. Table 3-1 presents comment topics received and where the comments are addressed in this Plan-EA.

Table 3-1. Public Scoping Comment Summary.

Comment Topic	Section Where Topic is Discussed
Request for information on land ownership and land use of the canal and if this will change after the project	Section 6.2
Importance of mitigation for removing the flume	Section 6.1.2
Request for numbers of public safety incidents	Section 4.3

Comment Topic	Section Where Topic is Discussed
Effect on vegetation and trees	Section 6.6.2
Concern for who would be responsible for maintaining trees and vegetation that die after piping	Section 6.6.2
Effect on aesthetics	Section 6.7.2
Concern for groundwater and aquifer recharge, and water availability for private wells	Section 6.8.2.3
Concern for property values of the adjacent landowners	Appendix D, NEE
Amount of water conserved by project, mechanism by which water would be conserved, and how the conserved water would be distributed in the Deschutes River	Section 6.8.2
Request to permanently commit 100 percent of water conserved through the project instream	Section 6.8.2
Importance of instream flows for the health of the Deschutes River and the associated fish, aquatic species, and general wildlife	Sections 4.8 and 4.9
Concern that seepage loss numbers in the Preliminary Investigative Report (PIR) are incorrect	Appendix E.4
Request for Section 12 consultation with U.S. Fish and Wildlife Service	Section 7
Effect on riparian habitat	Section 6.10.2
Effect on wildlife, including mammals, insects, and birds	Section 6.11.2
Concern for building along a Wild and Scenic Waterway	Section 6.12.2
Importance of scenic value of open canal to residents	Section 4.7
Request for additional alternative analyses, including canal lining, on-farm efficiency, piping private laterals, duty reductions, and water leasing programs	Section 5

Comment Topic	Section Where Topic is Discussed
Concern for how the project will be funded and if patron's costs will increase after the project is implemented.	Section 8.8
Effect of construction on property owners	Section 6.7.2
Concern that trespassers will walk above pipe and access private property after the project is implemented.	Section 5.3.2

3.4 Identification of Resource Concerns

Resource concerns identified through scoping comments include cultural resources, socioeconomics, soils, vegetation, visual resources, surface water, groundwater, aquatic resources, wetlands, and terrestrial wildlife. Table 3-2 provides a summary of resource concerns and their relevancy to the proposed action. Resource items determined not relevant were eliminated from detailed study; resources determined relevant were carried forward for analysis.

Table 3-2. Summary of Resource Concerns for the Arnold Irrigation District Infrastructure Modernization Project.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Air			
Air Quality		X	Oregon Department of Environmental Quality (ODEQ) air quality data indicates that the entire project area is in attainment for all criteria pollutants. Emissions from equipment associated with construction activities would occur; however, such emissions are considered negligible when compared to background levels and the application of best management practices (BMPs).
Soils			
Soils	X		Construction of the project could affect soils.
Prime Farmlands	X		Prime farmlands occur in the project area and could be affected by the project.
Human Environment			

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Environmental Justice		X	The proposed action is not located near any racial, socioeconomic, or environmental justice groups, and therefore would comply with EO 12898.
Cultural Resources	X		Consultation with the SHPO, THPO, and other consulting parties including affiliated tribes is required for compliance with Section 106 of the NHPA.
Land Use	X		Construction and operation of the project could affect land use.
National Parks, Monuments, and Parklands		X	No relevant impact. The District has a ROW for the short section of the project area that crosses Newberry National Volcanic Monument, and construction is not anticipated to occur outside of the ROW.
Noise		X	No relevant impact to noise. With implementation of BMPs, noise impacts during construction would be negligible and temporary.
Public Safety	X		Drowning risk in the open canal could be beneficially affected.
Visual Resources	X		Visual resources in the project area could be affected where the open canal would be altered.
Socioeconomics			
Local and Regional Economy	X		The proposed action involves an expenditure of public funds, which could affect the local and regional economy.
National Economic Efficiency (NEE)	X		A NEE analysis has been completed as required by the Departmental Manual (DM) 9500-013, Guidance for Conducting Analyses Under the PR&G.
Vegetation			

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Invasive Species/Noxious Weeds		X	No relevant impact. With implementation of BMPs, the spread of noxious weeds during construction would be avoided.
Mature Trees	X		Direct and indirect effects on mature trees could occur.
Special Status/Threatened or Endangered Species		X	None have been observed in the project area, and no designated critical habitat occurs in that area.
Water			
Coastal Zones		X	None present.
Groundwater Quantity, Aquifer Recharge	X		Construction and operation of the project could affect aquifer recharge.
Regional Water Resources Plans		X	The proposed action does not consider altering the management of any regional water resources.
Surface Water Quality	X		The proposed action could affect surface water quality by increasing flow in the Deschutes River.
Surface Water Quantity	X		The proposed action could affect surface water quantity by increasing flow in the Deschutes River.
Wild and Scenic Rivers	X		The proposed action could indirectly affect reaches of the Deschutes River that are designated Wild and Scenic River.
Wetlands and Riparian Areas			
Wetlands and Riparian Areas	X		Wetlands and riparian areas could be affected by project construction activities or changes in water levels.
Fish and Wildlife			
Coral Reefs		X	None present.

Resource	Relevant to the proposed action?		Justification
	Yes	No	
Endangered Species	X		Oregon spotted frog, bull trout, steelhead, or their habitats are known to occur in waterways (not including ditches/irrigation canals) that could be affected by the project.
Essential Fish Habitat (EFH)		X	Since the project would not adversely affect EFH, consultation under the Magnuson Stevens Act is not expected to be required.
Fish and Fish Habitat	X		The proposed action could affect fish habitat within waterbodies associated with District operations.
General Wildlife and Wildlife Habitat	X		Construction and operation of project components could affect wildlife near District operations.
Ecosystem Services			
Provisioning Services	X		Provisioning services supported by water quantity, quality, and availability could be impacted by the proposed action.
Regulating Services	X		Regulating services supported by water quantity, quality, and availability could be impacted by the proposed action.
Cultural Services	X		Cultural services supported by water quantity, quality, and availability could be impacted by the proposed action.

BMP = best management practice; EE = Environmental Evaluation; EFH = Essential Fish Habitat; EO = Executive Order; NEE = National Economic Efficiency; NHPA = National Historic Preservation Act; ODEQ = Oregon Department of Environmental Quality; PR&G = Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments; SHPO = State Historic Preservation Office; THPO = Tribal Historic Preservation Officer

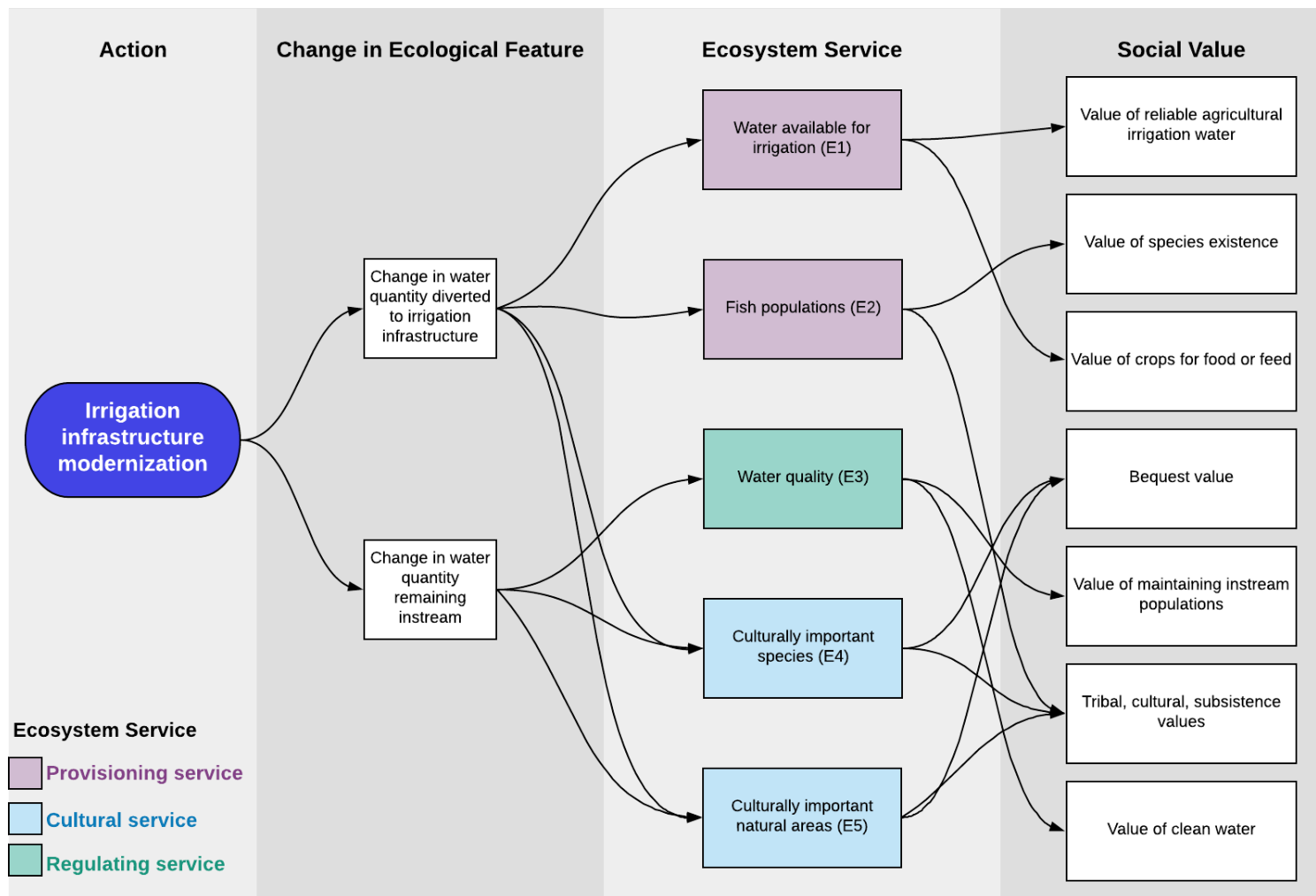
4 Affected Environment

The following sections describe the existing ecological, physical, biological, economic, and social resources of the project area and areas that could be affected by the operation of the AID system. The project area is defined in Section 1.2. Per requirements of the PR&Gs, where applicable, this Plan-EA describes the ecosystem services associated with each resource. Ecosystem services refer to the benefits that people and their communities derive from their natural environment in which they live. Availability of water for consumption, buffering against crop failure through pollination, and providing places in which people value living are all examples of benefits that flow from nature to people. Because these ecosystem services contribute to people’s “health, wealth, and well-being,” but often cannot be quantified in the same way as services sold in marketplaces, federal investment into projects that could impact ecosystems and natural resources require an ecosystem services assessment to illuminate how management decisions will enhance, sustain, or degrade the benefits that nature provides (USDA 2017; Olander et al. 2018). An assessment of links between ecological function and social well-being helps to ensure that beneficial and detrimental ecological impacts of a project are recognized and that detrimental impacts are minimized to the extent possible (EEA 2019).

Per federal guidance, this Plan-EA assesses ecosystem services based on three of the four service categories (USDA 2017):

- (1) Provisioning services: tangible goods provided for direct human use and consumption, such as food, fiber, water, timber or biomass;
- (2) Regulating services: services that maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe—examples include flood and disease control, water filtration, climate stabilization, or crop pollination;
- (3) Cultural services: services that make the world a place in which people want to live—examples include spiritual, aesthetic viewsheds, or tribal values; and
- (4) Supporting services: services that refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production.

Figure 4-1 shows a concept diagram that highlights the ecosystem services that interact with District operations and provides a baseline for discussion in Section 6. The diagram links an action that would modernize District infrastructure with potentially impacted ecosystem features and the provisioning, regulating, and cultural services that these ecosystems provide to people. Supporting services are not evaluated in this Plan-EA because they give rise to and support the final ecosystem services (Provisioning, Regulating, and Cultural) (EEA 2019; USDA 2017).



Note: 1) E1 through E5 refer to ecosystem services 1 through 5. These services are referenced and explained in more detail throughout Sections 4 and 6.
 2) Ecosystem services concept diagram developed by Farmers Conservation Alliance

Figure 4-1. Ecosystem services concept diagram for the Arnold Irrigation District Infrastructure Modernization Project.

4.1 Cultural Resources

Section 106 of the NHPA requires federal agencies to consider the effects of federally funded projects on historic properties, commonly referred to as cultural resources, prior to the expenditure of federal funds. The NHPA defines a historic property as “any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places, including artifacts, records, and material remains related to such a property or resource” (ACHP 2019).

There are no National Register-listed historic properties within the project area based on a review of the Oregon Historic Sites Database. To date, no surveys for historic properties have been completed for the project area. The District has hired a cultural resource specialist to complete site surveys for historic and archaeological resources in the project area, which will include surveys of the irrigation canals and related infrastructure. The cultural resource specialist will meet the appropriate Secretary of Interior Standards. As a part of the surveys, the cultural resources specialist will consider alterations to the historic viewshed that would potentially occur due to the proposed project. Consultation between NRCS, State Historic Preservation Office (SHPO), THPO, and affiliated tribes for compliance with Section 106 of the NHPA would occur prior to project implementation.

4.2 Land Use

4.2.1 Land Ownership

The project area crosses nearly all privately owned land. Approximately 0.3 miles of the flume crosses land that is part of the Newberry National Volcanic Monument, which is managed by the U.S. Forest Service (USFS). In this section, the District has a legal ROW beneath its infrastructure. The ROW along the flume is 60 feet in width on the westerly side, and 40 feet in width on the easterly side, of the centerline of the flume, for a total width of 100 feet.

The District has a ROW and easements underlying its entire infrastructure in the project area. The District’s ROW was granted under the Carey Desert Land Act of 1894. Under the Carey Act, AID’s ROW extends 50 feet on each side of the canal from the toe of the bank for a total width of 100 feet plus the width of the canal. Over the course of the last 100 years, there have been re-negotiations in specific areas concerning AID’s easements and ROW. AID re-maps and re-surveys its infrastructure, ROW, and easements on an ongoing basis to track changes over time.

4.2.2 Land Use

Within the project area, land use is entirely related to irrigation conveyance for agriculture. The project area crosses lands both served by and not served by the District. In the eastern half of the District, the project area crosses and is adjacent to rural residential lands; agricultural lands growing alfalfa/grass hay, pasture, and turf; and undeveloped land covered in western juniper (*Juniperus occidentalis*), ponderosa pine (*Pinus ponderosa*), and scrub-shrub species. Deschutes County has zoned a large proportion of the agricultural land and rural land that the project area crosses as Exclusive Farm Use. On the agricultural lands that the project area serves, farmers typically get two to three cuttings per year on hay and pasture grass. Table 4-1 presents information about crops grown in the District.

Table 4-1. Crops Grown in Arnold Irrigation District.

Crop	Total Acreage	Percent Acreage
Alfalfa/Grass Hay	1,600	36%
Grass (pasture, turf, etc.)	1,600	36%
Lawn/Garden, misc.	1,184	28%
Total	4,384	100%

Source: AID 2013

In the western half of the District, the project area crosses more developed land including residential areas such as Deschutes River Woods (DRW), a census-designated place and unincorporated community. Approximately 1.3 miles of the project area crosses land that falls within the Bend Urban Growth Boundary (UGB). This boundary is set to control urban sprawl and encroachment on agricultural and rural lands by mandating that the area inside the UGB be used for higher-density urban development.

4.2.3 Ecosystem Services

Agricultural land receiving water from project infrastructure provides ecosystem services categorized as *Provisioning service, Water available for irrigation* (Figure 4-1 [E1]). As described in Section 1.3, water from the Deschutes River is diverted into the District’s irrigation conveyance system and delivered to patrons for agricultural purposes. Provision of this water allows lands to be maintained for agricultural production. Feed grasses, including hay and pasture, contribute to the production of meat and dairy food; this water may also be used to grow crops for food for people.

4.3 Public Safety

The open canal in the project area poses a risk to public safety when it carries water. During the summer months, when irrigation water is flowing at peak volume in the canal, water depths range up to 6 feet and velocities range up to 5 feet per second. These conditions result in areas of deep, swift water that can make it difficult for a child or an adult to get to safety and can result in tragic outcomes. Within AID, cars have crashed into the canal and people have walked on the elevated section of the flume (C. Wills, personal communication, December 12, 2019). The risk of localized flooding from canal failure caused by sinkholes, rodents, and tree roots is also a concern for the District.

In other districts in Central Oregon, drowning deaths, or near drowning instances, have occurred in 1996, 1997, 2004, 2007, 2008, and 2014 in addition to multiple instances of injury (“19-year old Redmond woman died” 2014; KTVZ 2014; Chu 2004; Cliff 2008; Flowers 2004; Golden 2007; Minoura 2007).

4.4 Socioeconomic Resources

The project area falls within Deschutes County. Nearby communities include Bend and DRW, a census-designated place. These areas have seen steady growth; the county grew by 3 percent annually between 2000 and 2015 and Bend and DRW grew by 3.8 percent and 1 percent annually, respectively. The Oregon Office of Economic Analysis estimates that Deschutes County could reach a population of 241,223 by 2040, a 45 percent increase from the 2015 population (OEA 2013).

Health care and social assistance, retail trade, and accommodation and food services provided the highest number of employment positions (37 percent) throughout the county (OEA 2013).

4.5 Soils

The Wanoga Series are the predominant soils in the project area (83 percent of the project area; NRCS 2015b). These soils are moderately deep, well drained, and formed from volcanic ash. The Main Canal has failed various times due to sinkholes. After the 2019 irrigation season, the District found 15 sinkholes in the Main Canal that ranged from softball size to 8 feet by 6 feet (C. Wills, personal communication, December 12, 2019). Sinkholes develop from the seepage of irrigation water and canal soils into the underlying, porous rock. Tree roots and burrowing animals have also caused canal failure.

4.5.1 Farmland Classification

NRCS has developed technical soil groups that are associated with a particular soil type and a soil's rating for agricultural commodity production (NRCS 2015b). NRCS soil groupings within the project area are nearly all farmland of statewide importance (see Appendix E.2).

4.6 Vegetation

4.6.1 General Vegetation

AID lies in the Ponderosa Pine/Bitterbrush Woodland ecoregion Level IV (Thorson et al. 2003). Over the past 100 years, land use has changed much of the vegetation within the District. Urban development, roads, irrigated agriculture, land management, and livestock grazing are the primary causes of change to the plant communities. The introduction of cheatgrass (*Bromus tectorum*) has also threatened the survival and diversity of native perennial grasses and forbs, while increasing the risk of severe wildfire in the project area and adjacent undeveloped lands.

The ROW in the project area is largely mowed or otherwise maintained during the non-irrigation season to provide access to irrigation infrastructure for O&M. Along the flume, and where other vegetation has been allowed to grow, vegetation typically includes ponderosa pine, western juniper, big sagebrush (*Artemisia tridentata*) and low sagebrush (*Artemisia arbuscula*), and bunchgrass (*Poaceae* spp.) (INR and ORBIC 2014). In some sections of the project area, a fringe of opportunistic hydrophytic (water-loving) plants has sporadically formed along the margins of the top of the canal bank represented predominately by bulrush (*Scirpus spp.*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and willow (*Salix spp.*). Vegetation along the Main Canal is limited by grading and clearing during the non-irrigation season. No vegetation is allowed to develop within the canal.

4.6.2 Special Status Species

Within Deschutes County, three special status vegetation species potentially occur: federal candidate whitebark pine (*Pinus albicaulis*), Oregon threatened pumice grape-fern (*Botrychium pumicola*), and federal species of concern, Oregon threatened Peck's milkvetch (*Astragalus peckii*) (CBD 2019; ODA 2019). Based on the Oregon Biodiversity Information Center database, District observations, the Oregon Department of Agriculture identification of species population centers, and due to the elevation and plant communities these species generally inhabit, it is unlikely that any of these special status species would occur within the project area. Therefore, these special status plant species will not be discussed further.

4.6.3 Common and Noxious Weeds

The Deschutes Basin Board of Control determines a weed to be noxious if it is “injurious to public health, agriculture, recreation, wildlife, or any public or private property,” and “impacts and displaces desirable vegetation.” Furthermore, it is recognized that certain noxious weeds are so pervasive that they have been classified by Oregon Revised Statute (ORS) 569.350 to be a menace to public welfare (ODA 2017). The noxious and common weeds known to occur in the project area, along with their corresponding weed categories, are listed in Appendix E.3.

4.7 Visual Resources

The Main Canal consists of two visually distinct forms: 1) a canal that has been dug into the earth and 2) a wooden flume and trestle.

4.7.1 Open Canal Project Area and Adjacent Lands

Within the project area, the Main Canal consists of an open, earthen canal that lies flat against the landscape for 12.2 miles. In some segments of the project area, the water surface in the canal is a few feet lower than the landscape level and the canal banks are part of the landscape.

In addition to the canal, the project area includes vegetation and dirt or gravel maintenance roads that AID uses for canal maintenance. Herbaceous vegetation, grasses, shrubs, and trees growing within the project area can obscure the view of the canal from adjacent lands. The open canal and project area are visible from residences as well as at public road crossings (see Figure 4-2).

The view of the canal differs throughout the year. The District's irrigation season typically extends from April through October. During this time, the Main Canal carries water. From November through March, the canal does not carry water and is typically dry with a few remaining puddles in low-lying areas. The District provides “stock runs,” water delivered through the system to fill patrons' ponds for livestock, several times outside of the irrigation season. Although the canal is not a naturally formed waterway, some viewers may consider it a water feature during the irrigation season and a number of participants at the scoping meeting and comments submitted during the scoping period expressed concern about removal of this feature.



Figure 4-2. A view of the Main Canal and maintenance road from Knott Road looking northeast. Some residents have installed fences for safety purposes and do not have direct views of the canal from their property.

The western side of the project area passes through residential developments in DRW (Figure 4-3); while the eastern side of the project area passes through agricultural and undeveloped lands. In residential areas where homes are located along the canal, some homes have direct views of the canal while others do not because they have installed fences (Figure 4-2). Some residents believe that the canal view enhances the scenic quality of their backyard. In agricultural and undeveloped areas, a few rural residences are adjacent to the project area. Some rural residences have views of the canal, but vegetation obscures the canal in many locations.



Figure 4-3. The Main Canal passing residential homes in Deschutes River Woods, located west of Brookwood Blvd.

4.7.2 Flume Project Area and Adjacent Lands

After it is diverted from the Deschutes River, water travels 1 mile in a flume before it enters an earthen dug canal. The flume is a semicircular, open steel pipe on creosoted timber supports with concrete foundations. Below the diversion, the flume is elevated above the ground for the first 450 feet (Figure 4-4). The remaining sections of flume sit on the ground surface. The Arnold Canal Diversion and flume are visible to both recreationists on the Deschutes River (around RM 174.5) and those hiking the Deschutes River Trail (located on the west shore of the Deschutes River). The diversion infrastructure would not be affected by the project. The flume is located adjacent to a reach of the Deschutes River that is classified as a Scenic River Area (see Section 4.12).



Figure 4-4. A view of the aerial section of the flume with the Deschutes River in the background.

4.8 Water Resources

4.8.1 Arnold Irrigation District Water Rights and Operations

The District delivers water to irrigate 4,384 acres. Of that total acreage, 1,475 acres receive water directly from the Main Canal. The remaining irrigated lands receive water through lateral canals that branch off the Main Canal.

The District diverts both live flow and stored water from the Deschutes River at the Arnold Canal Diversion (RM 174.5) near Bend to meet its patrons' water needs. The District's primary source of water is live flow. AID diverts this water under Certificate 74197, which has a priority date of February 1, 1905, for 25 cfs and a priority date of April 25, 1905, for 125 cfs. The District also holds stored water rights on Crane Prairie Reservoir, located upstream from the District's diversion on the Deschutes River. AID's stored water right is a supplemental water right and is used on an as-needed basis.

Water for AID is conveyed from Crane Prairie Reservoir, east through the Deschutes River, through Wickiup Reservoir, and then north through the Deschutes River to the Arnold Canal Diversion at RM 174.5 (Figure 4-5).

AID's live flow water right identifies three seasons, each with different delivery rates (Table 4-2). These delivery rates are lower in season 1 and season 2 than in season 3. To meet demands during the late summer and fall, the District may supplement live flow with stored water to address reduced live flow availability caused by drought and/or prolonged heat.

Table 4-2. Delivery Rates and Irrigation Season Dates per Water Right Certificate 74197.

Season	Start Date	End Date	Start Date	End Date	Season Duration (Days)	Priority Date	Certificated Diversion Flow Rates (cfs)	Percent of Full Rate
1	April 1	April 30	Oct. 1	Nov. 1	62	2/1/1905	14.33	41%
						4/25/1905	71.63	41%
2	May 1	May 14	Sept. 15	Sept. 30	30	2/1/1905	18.73	53%
						4/25/1905	93.68	53%
3	May 15	Sept. 14	N/A	N/A	122	2/1/1905	25.00	100%
						4/25/1905	125	100%

cfs = cubic feet per second; N/A = Not Applicable

4.8.2 North Unit Irrigation District Water Rights and District Operations

North Unit Irrigation District (NUID) provides irrigation water to nearly 59,000 agricultural acres in Jefferson County, Oregon. NUID diverts natural flow from the Deschutes River and stored water released from Wickiup Reservoir at their diversion in Bend, Oregon (RM 164.8). Wickiup Reservoir, located on the Deschutes River 60 miles southwest of Bend, has a maximum capacity of 200,000 acre-feet.

NUID also operates a pumping plant on the Crooked River. This pumping plant is located where NUID’s main canal crosses the Crooked River. It provides water for both primary and supplemental use in NUID.

NUID historically sourced approximately 70 percent of its annual water supply from storage in Wickiup Reservoir (NUID 2019). With the HCP now in effect, winter flow releases from Wickiup Reservoir to meet minimum streamflow requirements set by the HCP in the Deschutes River are expected to result in a decline in storage water availability for NUID patrons. This decline in storage water availability is estimated to reduce water supply availability to NUID starting Year 8 of the HCP (i.e., January 2028) in normal to very dry years and in Year 13 of the HCP (i.e., January 2033) in all water type years. It is estimated that, following Year 13 of the HCP, water supply storage in Wickiup Reservoir in a normal water year will be reduced by 75,017 acre-feet, a 40 percent reduction (AID et al. 2020).

4.8.3 Surface Water Hydrology

Table 4-3 and Figure 4-5 present waterbodies associated with District operations. The upstream end of Lake Billy Chinook, at the confluence of the Deschutes, Crooked, and Metolius rivers, serves as the downstream boundary of the area associated with District operations.

Table 4-3. Waterbodies Associated with District Operations.

Name	Reach	Size	Tributary To	Project Nexus
Crane Prairie Reservoir	Not applicable	55,300 acre-feet	Not applicable	AID holds stored water rights in this reservoir.
Deschutes River	Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 233.5)	Not applicable	Releases from District reservoir affect flows in this reach.	Releases from Crane Prairie Reservoir affect flows in this reach.
Wickiup Reservoir	Not applicable	200,000 acre-feet	Not applicable	NUID holds stored water rights in this reservoir. AID irrigation water is conveyed through Wickiup Reservoir.
Deschutes River	Wickiup Reservoir (RM 226.8) to Arnold Canal Diversion (RM 174.5)	Not applicable	Columbia River	Releases from Crane Prairie and Wickiup reservoirs are developed to meet target flows set forth in the HCP in this reach.
Deschutes River	Arnold Canal Diversion (RM 174.5) to Lake Billy Chinook (RM 120.0)	Not applicable	Columbia River	AID's diversion affects flows in this reach.

AID = Arnold Irrigation District; HCP = Deschutes Basin Habitat Conservation Plan; NUID = North Unit Irrigation District; RM = River Mile

Historically, the spring-fed Deschutes River had relatively consistent streamflow seasonally and annually (DRC 2012). Hydrologic conditions in the Deschutes River have changed with the construction and operation of reservoirs, dams, and diversions on the river and its tributaries. Water is now managed for irrigation use, resulting in lower flows downstream from reservoirs during the storage season (i.e., late fall, winter, and early spring), higher flows downstream from reservoirs during the irrigation season (April through October), and lower flows downstream from irrigation diversions during the irrigation season.

In November 2020, AID, seven other irrigation districts in the Deschutes Basin, and the City of Prineville finalized the Deschutes Basin HCP to support the issuance of incidental take permits by the USFWS and NMFS, under Section 10(a)(1)(B) of the federal ESA of 1973, as amended. The activities covered in the HCP modified the streamflow targets in the Deschutes River, which hold priority to irrigation use of the water, and will be implemented over time as discussed in the following subsections.

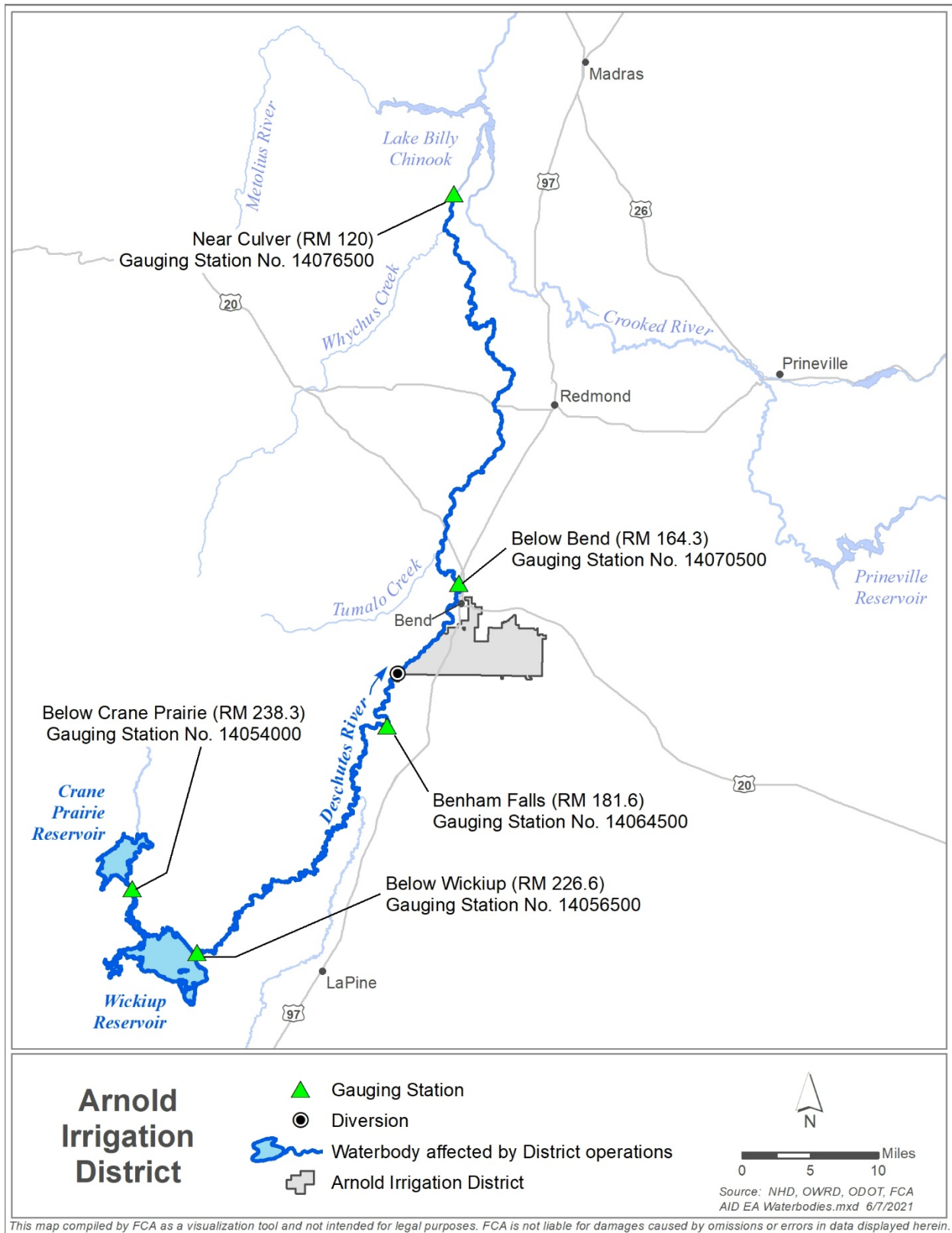


Figure 4-5. Waterbodies and gauging stations associated with District operations.

4.8.3.1 Crane Prairie Reservoir

Crane Prairie Dam is operated in coordination with Wickiup Dam and Reservoir, in accordance with the HCP. Storage and releases are directed by the OWRD Regional Watermaster and executed by Central Oregon Irrigation District (COID) personnel.

4.8.3.2 Wickiup Reservoir

Wickiup Reservoir is 5 miles downstream from Crane Prairie Dam and relies on snowmelt, releases from Crane Prairie Reservoir, and precipitation for inflow. Throughout the year, water is released as directed by the OWRD Regional Watermaster in accordance with the HCP and through an accounting arrangement whereby the storage accounts for COID, NUID, Lone Pine Irrigation District (LPID), and AID are balanced over the course of the irrigation season.

During the irrigation season, water released from Wickiup Dam is conveyed through the Deschutes River to COID's, AID's, and NUID's diversions in Bend. During the non-irrigation season, water released from the dam is conveyed down the Deschutes River to Lake Billy Chinook (RM 120.0). The HCP (AID et al. 2020) limits reservoir operations and a summary of the operation measures set forth by the HCP can be found in Appendix E.4.8.

4.8.3.3 Deschutes River (RM 238.5) to the Arnold Canal Diversion (RM 174.5)

Reservoir releases, tributary inflows, irrigation diversions, and groundwater interactions drive streamflow in the reaches of the Deschutes River from Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 233.5) and from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5). As described in the prior subsection, target flows in this reach are set forth in the HCP, which are summarized in Appendix E.4.8.

Figure 4-6 and Figure 4-7 display the Deschutes River's daily average baseline streamflow following the 2016 Settlement Agreement.⁸ Data for streamflow following the 2016 Settlement Agreement represent the October 2016 through September 2020 water years.

⁸ In 2016, as part of an interim agreement until the finalization of the HCP, AID and other districts that store water in Crane Prairie and Wickiup reservoirs agreed to maintain a minimum of 100 cfs in the Deschutes River outside the irrigation season (*Center for Biological Diversity et al. v. U.S. Bureau of Reclamation* and AID et al. 2016). This agreement is referred to as the 2016 Settlement Agreement and was maintained until the finalization of the HCP in 2020 (AID et al. 2020).

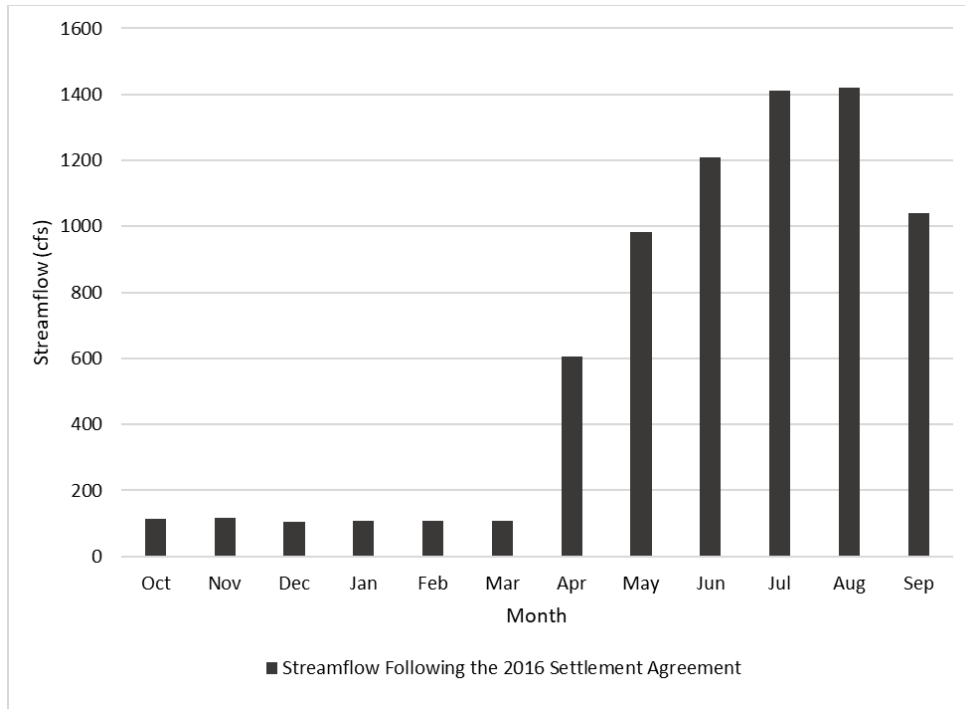


Figure 4-6. Streamflow in the Deschutes River downstream from Wickiup Reservoir at OWRD Gauge No. 14056500.

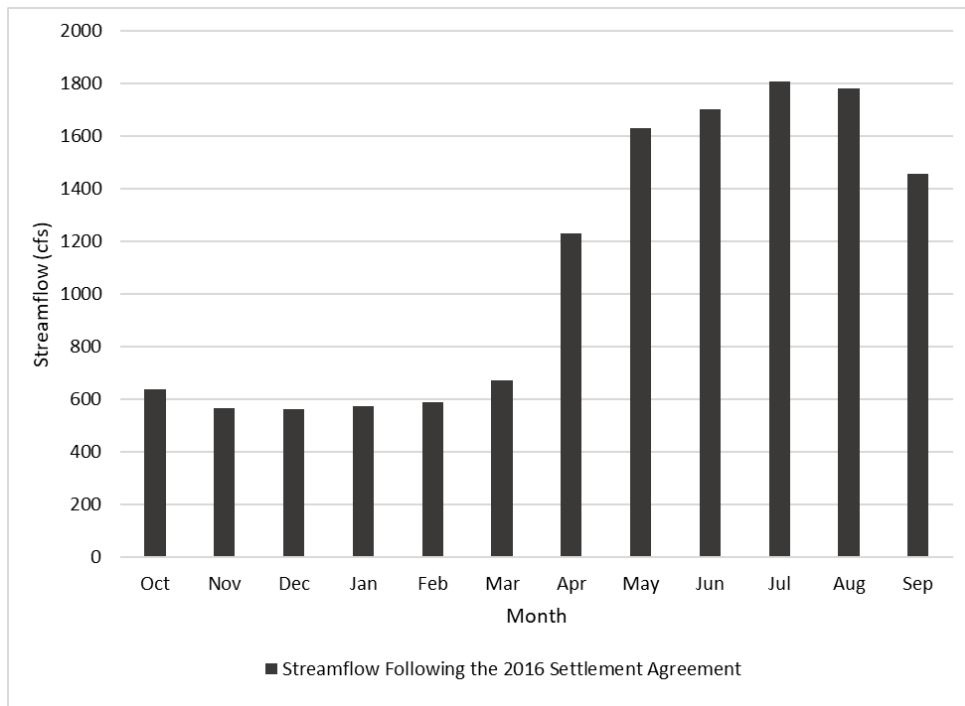


Figure 4-7. Daily average streamflow in the Deschutes River at Benham Falls at OWRD Gauge No. 14064500.

4.8.3.4 Deschutes River, Arnold Canal Diversion (RM 174.5) to Lake Billy Chinook (RM 120.0)

Central Oregon, Arnold, Lone Pine, North Unit, and Swalley irrigation districts divert water from the Deschutes River near Bend, influencing streamflow patterns in the Deschutes River between Arnold Canal Diversion (RM 174.5) and Lake Billy Chinook (RM 120.0). Historically, these irrigation districts maintained a minimum of 30 cfs instream in this reach during the irrigation season under a voluntary agreement. Extensive conservation efforts by the irrigation districts and their partners starting in the 2000s have enhanced streamflow during the irrigation season, maintaining approximately 130 cfs downstream from their diversions during the summer irrigation season.

Figure 4-8 displays the Deschutes River streamflow downstream from Bend. The figure demonstrates the daily average baseline streamflow following the 2016 Settlement Agreement (October 2016 to September 2020).

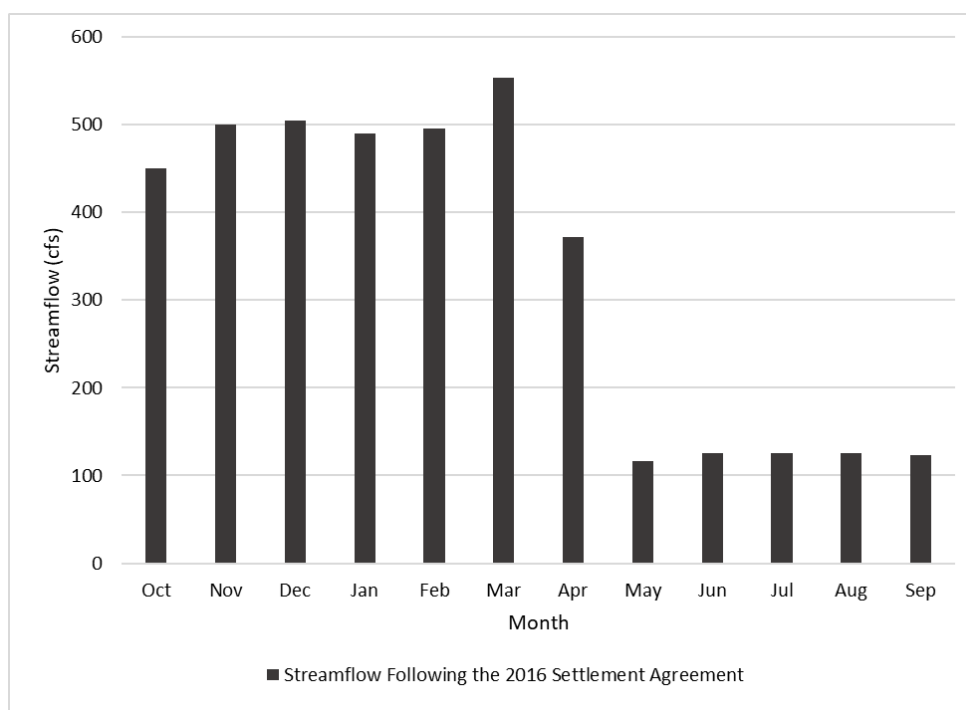


Figure 4-8. Daily average streamflow in the Deschutes River downstream from Bend at OWRD Gauge No. 14070500.

Oregon Department of Fish and Wildlife’s (ODFW’s) pending water right in this reach requests a year-round flow of 250 cfs, providing a target for what streamflow is needed for fish, wildlife, their habitat quality, or recreation between North Canal Dam (RM 164.8) to Lake Billy Chinook (RM 120.0) (Appendix E.4).

4.8.3.5 Drainage Courses

The District does not allow its canal and lateral system to be intentionally utilized for stormwater management. Any interception of stormwater, associated with overland flow in the area adjacent to the District’s conveyance system, is incidental to the purpose of conveying water for irrigation. Due to the geology and climate of the area, these occurrences are minimal.

4.8.4 Surface Water Quality

The Oregon Department of Environmental Quality (ODEQ) maintains a list of all surface waters in the state that are considered impaired because they do not meet water quality standards under Section 303(d) of the CWA (33 United States Code [U.S.C.] 1251 et seq.). The 2012 303(d) list is effective for CWA purposes. Waterbodies associated with District operations are included on Oregon’s 303(d) list for not meeting state water quality standards for aquatic weeds or algae, temperature, dissolved oxygen, pH, sedimentation, turbidity, chlorophyll a, *E. Coli*, and biological criteria (Table 4-4).

Water management in the Deschutes Basin has altered seasonal streamflow patterns, increasing streamflow above historical levels in some reaches, and decreasing streamflow below historical levels in others. Low streamflow impacts water quality in the Deschutes River by exacerbating temperature and dissolved oxygen problems. In addition, water quality often dictates the spread and extent of invasive aquatic species (McCormick et al. 2009), and these problems interact synergistically to degrade wildlife habitat within and around the Deschutes River. The following sections describe existing 303(d)-listed impairments in the waterbodies associated with District operations. ODEQ is required to develop total maximum daily loads for rivers and streams in the upper Deschutes Basin (these impairments may extend upstream or downstream of the reaches included in Table 4-4).

Table 4-4. Impaired Waterbodies Associated with District Operations.

Name	Listed Reach (River Miles)	Parameters Included on Oregon’s 303(d) List
Crane Prairie Reservoir	N/A	Aquatic weeds or algae
Deschutes River	Crane Prairie Reservoir (RM 238.5) to Wickiup Reservoir (RM 226.8)	Temperature
Wickiup Reservoir	N/A	Aquatic weeds or algae
Deschutes River	Wickiup Reservoir Dam (RM 226.8) to North Canal Dam (RM 164.8) ¹	Temperature Dissolved oxygen pH Sedimentation Turbidity Chlorophyll a
Deschutes River	North Canal Dam (RM 164.8) to Lake Billy Chinook (RM 120.0)	Temperature Dissolved oxygen

Source: ODEQ 2012

N/A = Not Applicable; RM = River Mile

Notes:

¹ The Arnold Canal Diversion is located at RM 174.5 in the Deschutes River.

4.8.5 Groundwater

AID and its associated operations lie within the upper Deschutes Basin. Within the Basin, precipitation in the Cascade Range provides 3,500 cfs of annual groundwater recharge. Inflows from outside the Basin provide an additional 850 cfs of recharge. Canal seepage across the region provides approximately 411 cfs of additional recharge based on 2008 data (Gannett et al. 2001; Gannett and Lite 2013). Since the publication of Gannett and Lite (2013), subsequent canal lining and piping projects have reduced recharge from canal seepage.

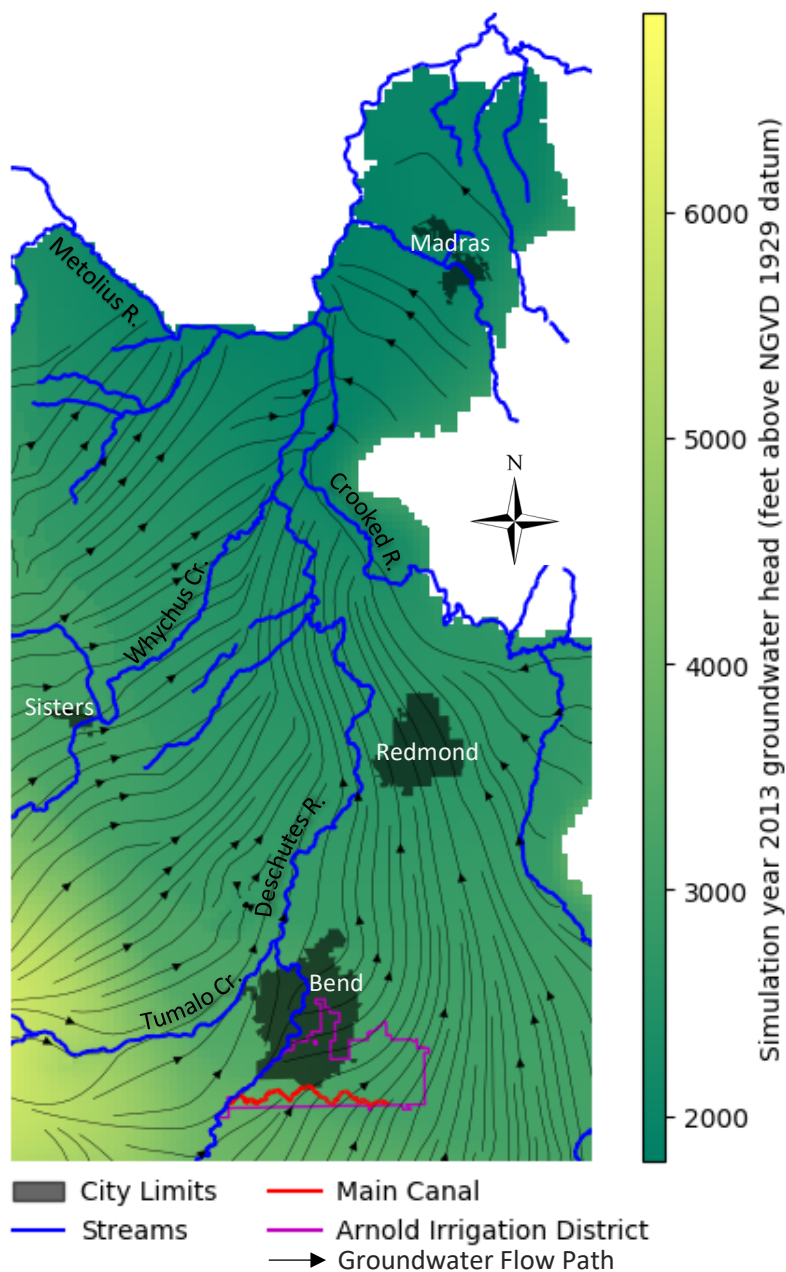
Due to the highly permeable geology of the area, groundwater levels and stream discharge are associated with movement of water between surface and groundwater systems. The rivers, streams, and irrigation canals in the upper Deschutes Basin all show seepage losses indicative of the area's permeable geology (Gannett et al. 2001). AID's Main Canal loses an estimated 32.5 cfs of water during the irrigation season (10,526 acre-feet annually),⁹ due to a combination of seepage related to the condition of the distribution system and permeable nature of the underlying soil and rock, and evaporation.

Gannett et al. (2001; 2017) mapped gaining and losing stream reaches in the upper Deschutes Basin. The reach of the Deschutes River from near Sunriver to Bend was mapped as a losing reach. Thus, canal seepage loss in AID is not returning to this reach of the river. Furthermore, groundwater flow direction estimated from simulated 2013 groundwater hydraulic head¹⁰ data (Gannett et al. 2017) are in a northeasterly direction from AID (Figure 4-9). The model results provide evidence that groundwater underlying AID flows eastward away from the Deschutes River before bending northward where it travels along paths to discharge locations north of Redmond, Oregon (Figure 4-9).

Cascade Range aquifers in the upper Deschutes Basin have experienced a general drying trend since the 1950s. Climate oscillations remain the primary driver of these declines (Gannett et al. 2001; Gannett et al. 2003). A U.S. Geological Survey study investigated the influence of canal lining and piping, groundwater pumping, and climate on water-level trends in the region between 1997 and 2008 (Gannett and Lite 2013). The study predicted an approximate 5- to 14-foot decline in groundwater levels in the central part of the Basin, which lies north of the proposed project area. The study found that 60 to 70 percent of the measured decline was associated with climate variations, 20 to 30 percent of the measured decline was associated with increased groundwater pumping, and 10 percent was associated with canal lining and piping. At the basin-scale, natural climate-induced fluctuations in groundwater discharge largely mask the effects of development on discharge from the regional aquifer (Gannett et al. 2001).

⁹ This loss is derived from a loss assessment performed in 2016 and is representative of the District's annual losses during the peak irrigation season, when diversion rates are typically highest (May 15 to- September 14). See Appendix E.4 for information on water loss in the system.

¹⁰ Groundwater hydraulic head is the level to which groundwater will rise in a well and is dependent on both elevation and pressure. Groundwater flows from areas of high hydraulic head to low hydraulic head.



Source: Gannett et al. 2017

Figure 4-9. Estimated groundwater flow paths determined from simulated hydraulic head data.

4.8.6 Ecosystem Services

Water flowing through the Deschutes River provides the following ecosystem services.

Provisioning service, Water available for irrigation (Figure 4-1 [E1]): As described in Sections 1.3 and 4.8.3, water from the headwaters of the Deschutes Basin is stored, conveyed, and diverted, affecting the upper and middle reaches of the Deschutes River. This water provides irrigation for food and feed and maintenance of agricultural lands.

Regulating service, Water quality (Figure 4-1 [E3]): The amount of water instream affects water quality including temperature, turbidity, sediment, and pollutants. In general, low streamflow challenges a waterbody's ability to resist warming because less water heats faster than more water. Because of this property, greater instream flow can help to keep water cool—an important factor for temperature sensitive, aquatic species living in these stream habitats (Section 4.9). In cold, winter months, however, the banks of waterbodies with low streamflow are susceptible to freeze-thaw cycles that can increase bank erosion and increase sediment in the water. Given pollutant input, less water also leads to higher concentration of pollutants than does more water. Therefore, greater streamflow also helps to dilute pollutants. Section 4.8.3 describes surface water quality in the waterbodies associated with District operations.

4.9 Fish and Aquatic Resources

The affected environment for fish and aquatic species includes waterbodies that are associated with AID operations (Table 4-3). These waterbodies include Crane Prairie and Wickiup reservoirs, the Deschutes River from the Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5), the Deschutes River from the Arnold Canal Diversion (RM 174.5) to Lake Billy Chinook (RM 120.0). The Pelton Round Butte Dam creates Lake Billy Chinook through the impoundment of the Crooked, Deschutes, and Metolius rivers.

The Deschutes Basin is part of 10 million acres of lands ceded to the United States by the CTWS. Under rights reserved by federal treaty, tribal members harvest salmon and steelhead from the rivers of the Deschutes Basin. Tribal fishing opportunity has become severely restricted because of fish passage barriers, low fish abundance, and the need to protect weak or threatened stocks (CTWS 2020). CTWS, ODFW, Portland General Electric (PGE), and local partners are actively engaged in efforts to recover fish populations through fish passage barrier removal, habitat restoration, hatchery supplementation, research and monitoring, and harvest management (PGE 2020).

4.9.1 General Fish and Aquatic Species

The District's canals do not support resident or anadromous fish or threatened and endangered aquatic species. Fish screens were installed in 2001 at the Arnold Canal Diversion on the Deschutes River (RM 174.5). These fish screens separate water diverted for consumptive use from debris and water left instream. The screens also prevent any fish from entering the District's irrigation conveyance system by returning fish to the river downstream of the diversion (Biota and R2 2013).

Fish and aquatic species documented in the waterbodies associated with District operations are listed in Appendix E.5. The summer steelhead salmon (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and sockeye salmon (*Oncorhynchus nerka*) in these waterbodies are part of a reintroduction effort that began in 2009 to mitigate for blocked fish passage at the Pelton Round Butte Dam Complex (ODFW and CTWS 2008). Chinook and sockeye salmon are unable to navigate Steelhead Falls, which creates the uppermost distribution limit for salmon in the Deschutes River at RM 128.0. Summer steelhead are able to pass upstream of Steelhead Falls but are unable to navigate upstream of Big Falls at RM 132.0. Big Falls is considered the uppermost limit of anadromous fish distribution in the Deschutes River (ODFW 1996).

Low streamflow and water quality impairments are recognized as key limiting factors for fish populations in the basin (NMFS 2009). Low streamflow and elevated water temperatures in the middle Deschutes River during the irrigation season negatively affect salmonid growth and survival (Recsetar et al. 2012). Availability of cold-water refugia for temperature-sensitive fish species is of key importance when river temperatures rise above acceptable standards. Water temperatures that are out of the normal range for a given fish species can increase physiologic stress; increase susceptibility to predators; and influence growth rates, feeding, metabolism, and development. Water temperature changes in the affected area are described in Section 4.8.4.

In addition to fish, other aquatic species are potentially found within or along waterbodies that are associated with District operations. These other aquatic species include bullfrog (*Lithobates catesbeianus*), western toad (*Anaxyrus boreas*), Pacific treefrog (*Pseudacris regilla*), and long-toed salamander (*Ambystoma macrodactylum*). The western toad, Pacific treefrog, and long-toed salamander are native to Oregon and may be present in open irrigation canals and adjacent banks where there is suitable vegetation (S. Wray, personal communication, November 17, 2017). The bullfrog is an invasive species that was introduced to Oregon in the early 1900s. Bullfrogs are voracious predators that eat any animal they can swallow. The International Union lists all of these amphibians as species of least concern for Conservation of Nature (IUCN 2017).

Two species of mollusks may be found in waterbodies associated with District operations: western pearlshell mussel (*Margaritifera falcata*) and western ridged mussel (*Gonidea angulata*). The western ridged mussel is currently ranked as vulnerable by IUCN (2017) and recognized as a species of greatest conservation need by the State of Oregon (OCS 2016). The western pearlshell mussel is ranked as near threatened by IUCN (2017).

4.9.2 Federally Listed Fish and Aquatic Species

A list of fish and aquatic species protected under the ESA (16 U.S.C. 1531 et seq.), as amended in 1998, that are known or expected to occur in waterbodies associated with District operations, was obtained using the USFWS Environmental Conservation Online System Information for Planning and Consultation (IPaC) System. The IPaC indicated that three federally listed fish and aquatic species, Oregon spotted frog (*Rana pretiosa*), bull trout (*Salvelinus confluentus*), and Middle Columbia River steelhead salmon (*Oncorhynchus mykiss*), are, or may be found, in the waterbodies associated with AID operations (USFWS 2019). None of these species are known to occur within the irrigation canals within the project area.

Oregon spotted frog

USFWS lists Oregon spotted frog as threatened under the ESA. The Oregon spotted frog and its designated critical habitat occur in the Deschutes River upstream of Bend (RM 173.0) and in Crane Prairie and Wickiup reservoirs (Appendix E.5; Figure E-1). USFWS has identified Primary Constituent Elements (PCEs) for Oregon spotted frog critical habitat (81 *Federal Register* [Fed. Reg.] 29335, 2016). They represent the biological and physical features that are essential to the conservation of a species and describe habitat components that support one or more life stages of the species. PCEs for Oregon spotted frog describe areas that have appropriate water depths and

refuge from predators, aquatic connectivity, and absence of non-native predators. A detailed list of Oregon spotted frog critical habitat PCEs is provided in Appendix E.5.

Bull trout

USFWS lists bull trout as threatened under the ESA. Bull trout are known to be present in the Deschutes River from Big Falls (RM 132.0) to Lake Billy Chinook (RM 120.0) (ODFW 2005, 1996). Designated critical habitat for bull trout also occurs in the Deschutes River from Big Falls (RM 132.0) to Lake Billy Chinook (RM 120.0) (Appendix E.5; Figure E-1). The PCEs for bull trout describe habitat that has aquatic connectivity, complex habitat structure, water temperatures ranging from 2 degrees Celsius to 15 degrees Celsius, natural variability in streamflow, a sufficient food base, and the absence of non-native predatory and competing fish (70 Fed. Reg. 56211, 2005). A detailed list of Critical Habitat PCEs for bull trout is provided in Appendix E.5. Although critical habitat for bull trout is designated in the Deschutes River from Big Falls to Lake Billy Chinook, electrofishing conducted in 2014 for an occupancy study found no evidence of bull trout in this section of the river (Starcevich 2016).

Middle Columbia River steelhead

Steelhead populations listed as threatened under the ESA are present within waterbodies affected by District operations (Appendix E.5; Figure E-2). However, the population in the Deschutes River (Middle Columbia River steelhead) is classified as a non-essential experimental population under Section 10(j) of the ESA and critical habitat is not designated (76 Fed. Reg. 28715, 2011). Because of this classification, and because the non-essential experimental population is located outside of a National Wildlife Refuge System and a National Park System, the population is treated as “proposed for listing” under ESA Section 7 (76 Fed. Reg. 28715, 2011; 81 Fed. Reg. 33416, 2016).

4.9.3 State-Listed Species

ODFW maintains a list of native wildlife species in Oregon that have been determined to be either “threatened” or “endangered” according to criteria set forth by Oregon Administrative Rule [OAR] 635-100-0105 (ODFW 2021). There are no state-listed threatened, endangered, or candidate fish or aquatic species known to occur within the waterbodies associated with AID operations or in the irrigation canal within the project area.

4.9.4 Ecosystem Services

Fish and aquatic species in the Deschutes River provide the following ecosystem services.

Provisioning service, Fish Populations (Figure 4-1 [E2]): The waterbodies associated with District operations provide year-round trout fishing opportunities (ODFW 2019). Brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*) in the Deschutes River provide recreational anglers with opportunities to harvest fish for consumption.

Cultural service, Culturally important species (Figure 4-1 [E4]): People’s values for species conservation may arise from personal use (i.e., enjoying seeing the species and/or its habitat), personal beliefs and moral ethics (i.e., believing protecting a species and its habitat is the right thing to do), altruism (i.e.,

believing a resource should be protected so that others can use it or benefit from it), and/or a desire to bequest the resource (i.e., believing a resource should be protected for future generations). To many residents of Central Oregon, the conservation of fish and aquatic life has come to represent the restoration of the Deschutes River ecosystem. In addition, members of the CTWS have fishing rights and rely on the Deschutes River fisheries for subsistence. Culturally important fish and aquatic species in the Deschutes River ecosystem include species such as salmon, bull trout, and steelhead for both subsistence and cultural values, and Oregon spotted frog for cultural values.

4.10 Wetlands and Riparian Areas

Wetlands and riparian areas affected by District operations occur in the project area and 111.8 miles of natural waterbodies associated with District operations (Table 4-3).

Wetlands perform a number of valuable functions including water storage, water filtration, and biological productivity. They can also support complex food chains that provide sources of nutrients to plants and animals and provide specialized habitat for a wide variety of aquatic and terrestrial species. Wetlands in the area associated with the proposed action may be subject to federal or state regulations depending on their characteristics. Within the State of Oregon, wetlands are managed under two regulations: the CWA and Oregon Removal-Fill Law.

The U.S. Army Corps of Engineers (USACE) administers Section 404 of the CWA with the oversight of the U.S. Environmental Protection Agency (USEPA). This law regulates the dredge or fill of wetlands over which the USACE has jurisdiction (or “jurisdictional wetlands”).

Section 404 of the CWA defines wetlands as “those areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (USACE 1986).

The Oregon Department of State Lands (ODSL) implements the Removal-Fill Law (ORS 196.800-990), which regulates the removal or fill of material in wetlands or waterways, requiring any person who plans to “remove or fill” material within “waters of the state” to obtain a permit from ODSL.

Per the Oregon Removal-Fill statute OAR 141-085-0515(9), an irrigation ditch is not jurisdictional under Oregon Removal-Fill permitting if it meets both of the following (ODSL 2013):

- The ditch is operated and maintained for the primary purpose of irrigation; and
- The ditch is dewatered¹¹ outside of the irrigation season except for isolated puddles in low areas.

¹¹ “Dewatered” means that the source of the irrigation water is turned off or diverted from the irrigation ditch. A ditch that is dewatered outside of the irrigation season may be used for temporary flows associated with stormwater collection, stock water runs, or fire suppression.

On July 24, 2020, the USACE and USEPA signed a memorandum providing a clear, consistent approach regarding the application of the exemptions from the regulation under Section 404(f)(1)(C) of the CWA for the construction or maintenance of irrigation ditches and for the maintenance of drainage ditches. As defined in this memorandum, “irrigation ditch” is defined as a ditch that either conveys water to an ultimate irrigation use or place of use, or that moves and/or conveys irrigation water away from irrigated lands. Additionally, as proposed in the memorandum, should the irrigation ditch not occur in Waters of the United States, the proposed activity is not prohibited by nor regulated under Section 404 of the CWA.

Riparian areas are transition zones between waterbodies and adjacent upland areas that support hydrophytic vegetation that is dependent upon the hydrology of the waterbody. Section 404 of the CWA defines riparian areas as “areas next to or substantially influenced by water. These may include areas adjacent to rivers, lakes, or estuaries” (USEPA 2015). Riparian areas are typically associated with high-water tables due to the close proximity to aquatic ecosystems, certain soil characteristics, and a range of vegetation that requires free water or conditions that are moister than normal (Oakley et al. 1985).

4.10.1 Wetland and Riparian Areas along the Project Area

Water typically flows through AID’s system during the irrigation season between April 1 and November 1. Water may also occasionally flow through the system outside of the irrigation season for stock water and as standing water following rain or snow events. Hydrophytic plants are sometimes found along the banks of the Main Canal within the project area, as the hydrology provided by the canal can create favorable growing conditions during a portion of the year. However, the District actively keeps the canal banks clear from vegetation; therefore, the edges of canals do not provide a functioning riparian environment.

The National Wetland Inventory¹² (NWI) geographic information systems data (USFWS 2016) was used as a first-step approach in identifying and evaluating potential wetlands in the project area. Through an analysis of NWI data and examining aerial imagery, there were no potential sites identified as Freshwater Emergent Wetlands within or adjacent to the project area that could be affected by implementation of the proposed project. At the time of writing this Plan-EA, this information has not been field-verified.

4.10.2 Wetland and Riparian Areas along Natural Waterbodies Associated with District Operations

Wetlands are found within and sporadically adjacent to Crane Prairie Reservoir, Wickiup Reservoir, and the 111.8 miles of Deschutes River associated with District operations. The types of wetlands that are found include marshes and wet meadows that are dominated by herbaceous plants and swamps dominated by herbaceous plants, shrubs, or trees (UDWC 2003). Riparian areas of varying size and quality also occur adjacent to natural waterbodies associated with District operations. Low streamflow in late fall, winter, and early spring associated with upstream reservoir storage limit

¹² The NWI code uses the Cowardin classification system. For further information about Cowardin classifications, refer to *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979).

riparian vegetation in the Deschutes River (RDG 2005). Low streamflow along these reaches can expose the channel bed and riverbanks, facilitating increased erosion and fine sediment delivery following freeze-thaw processes and increased spring streamflow (RDG 2005). Because streamflow is strongly correlated with critical physical and biological characteristics of the river, it influences the functions of associated riparian areas (National Research Council 2002). As riparian areas become hydrologically disconnected from their adjacent stream channels with reduced streamflow, they lose many of their ecological functions.

4.11 Wildlife Resources

4.11.1 General Wildlife

Generally, wildlife present within the project area consists of habitat generalists or edge species with the ability to adapt or exploit the agricultural environment. These species are tolerant to disturbance and include deer, coyote, skunk, grey squirrel, raccoon, and red-tailed hawk (Blair 1996; Ditchkoff et al. 2006; McKinney 2002; and Shochat et al. 2006).

Wildlife within the project area may use the canal system as a water source and dispersal corridor. Additionally, where not cleared, vegetation along the canal can provide food, cover, and breeding sites for many wildlife species throughout the year. Interaction between large ungulates and open canals sometimes results in wildlife injury or death if the animal falls into the open canal and is unable to find its way out (G. Jackal, personal communication, November 15, 2019).

4.11.2 MBTA/BGEPA Species

There are multiple bird species with the potential to occur within the project area, some of which are protected under the Migratory Bird Treaty Act (MBTA) or the Bald and Golden Eagle Protection Act (BGEPA). Although migratory birds are known to travel through the project area and its vicinity, limited habitat is provided within the project area due to District maintenance activities that remove vegetation on an annual basis.

USFWS maintains a database of known golden and bald eagle nesting sites. One section of the project area near Horse Butte Road is approximately 0.6 mile from a golden eagle nesting area, and a second section of the project area near Knott Road is approximately 1.9 miles from a golden eagle nesting area (E. Weidner, personal communication, December 17, 2019 and February 13, 2020). Early coordination with a USFWS biologist regarding MBTA/BGEPA species is ongoing (E. Weidner, personal communication, November 25, 2019). Appendix E.6 has a list of MBTA/BGEPA species potentially occurring within the project area.

4.11.3 Federally Listed Species

A review of available USFWS data showed that the gray wolf (*Canis lupus*), “is known or expected to be on or near the project area” (USFWS 2019). Although the gray wolf is listed as federally endangered throughout the species’ range, which includes the project area, only two locations of known wolf activity occur in Oregon: the Rogue area in southern Oregon and areas surrounding La Grande in northeast Oregon. There is no known wolf activity in the project area. Current disturbance within the project area indicates that the project would have negligible effect on any wolves that may disperse through the area; therefore, the gray wolf will not be discussed further (E.

Weidner, personal communication, November 25, 2019; USFWS 2021). Federally listed aquatic species are discussed in Section 4.9.2.

4.11.4 State-Listed Species

ODFW maintains a list of native wildlife species in Oregon that have been determined to be either threatened or endangered according to criteria set forth by rule OAR 635-100-0105 (ODFW 2021). There are no state-listed terrestrial wildlife species known to occur within the project area.

4.12 Wild and Scenic Rivers

Two sections of the Deschutes River that are part of the federal Wild and Scenic Rivers system (PL 90-542; 16 U.S.C. 1271 et seq.) have the potential to be affected by the proposed project:

- The Deschutes River from Wickiup Reservoir (RM 226.8) to the Bend UGB at the southwest corner of Section 13, T18S, R11E (approximately RM 172.0) is classified as “Scenic”¹³ and “Recreational”¹⁴ with Outstandingly Remarkable Values (ORVs) including Cultural, Fish, Geologic, Recreation, Scenery, Wildlife, and Vegetation. This section of the Deschutes River has no sections classified as Wild (USDA 1996).
- The Deschutes River from Odin Falls (RM 139.9) to the upper end of Lake Billy Chinook (RM 120.0) is classified as “Scenic” with its ORVs including Cultural, Fish, Geologic, Recreation, Scenery, Wildlife, Hydrology, Botanical/Ecological, and Wilderness (BLM 1992).

Additional information regarding the ORVs is provided in Appendix E.7.

The overall goals of the Wild and Scenic River Management Plans (USDA 1996 and U.S. Department of Interior 1992) are to maintain the current character of the river area and provide long-term protection and enhancement of its ORVs. Additional goals include protecting and enhancing instream and land-based biological, cultural, and physical resources and providing for appropriate recreational use and public access while maintaining the wild and scenic nature of the river (USDA 1996 and U.S. Department of Interior 1992).

The AID diversion is located on the Deschutes River at RM 174.5. This section of the Deschutes River is classified as a Scenic River Area. Within this area, all new structures, improvements, and development shall comply with the Land Management Rules as described in OAR 736-40-035 and OAR 736-40-040(1)(b)(B).

¹³ The section from the north boundary of Sunriver to Lava Island Camp was classified as Scenic, which is defined as, “those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads” (USDA 1996).

¹⁴ The sections from Wickiup Dam to the northern boundary of Sunriver and the section from Lava Island to the Bend UGB were classified as Recreational, which is defined as, “those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past” (USDA 1996).

In addition to federally designated Wild and Scenic Rivers, several reaches of the Deschutes River within the project’s planning area are designated Oregon State Scenic Waterways (ORS 390.826). These locations, with specific exclusions and classifications, are detailed in Table 4-5.

Table 4-5. Designated Oregon Scenic River Waterways Associated with District Operations.

Waterbody Name	Classification	Reach
Upper Deschutes River	Scenic River Area ¹	From RM 224.5 to RM 204.0, except for Pringle Falls (RM 217.5 to RM 216.5)
	Scenic River Area	From the Deschutes National Forest boundary in Section 20, T19S, R11E (approximately RM 184.8) to the Bend UGB (approximately RM 172.0)
	River Community Area ²	From RM 226.4 to approximately RM 224.5; from RM 217.5 to RM 216.8; from RM 204.0 to about RM 199.0; and from RM 172.0 to RM 171.0
	Recreational River Area ³	From RM 190.6 to approximately RM 184.8
Middle Deschutes River	Scenic River Area	From Deschutes Market Road (approximately RM 157.0) to the south boundary of the Wilderness Study Area (approximately RM 131.0), except for the Clines Falls Dam and powerhouse between State Highway 126 Bridge (RM 144.9) and RM 144.0 and the Crooked River Ranch River Community Area (RM 129.9 to RM 131.5)
	River Community Area	From RM 164.0 to approximately RM 161.0; from RM 131.5 to RM 129.9; and from RM 125.25 to RM 124.3
	Recreational River Area	From the northern Bend UGB (RM 161.0) to Tumalo State Park (RM 158.0)
	Natural River Area ⁴	From the south boundary of the Wilderness Study Area as approximately RM 131.0 to Lake Billy Chinook (RM 120.0), except for RM 129.9 to RM 131.5

Source: Oregon Revised Statute [ORS] 390.826
 RM = River Mile; UGB = Urban Growth Boundary

Notes:

¹ Those designated scenic waterways or segments with related adjacent lands and shorelines still largely primitive and largely undeveloped, except for agriculture and grazing, but accessible in places by roads. These classified areas will be administered to maintain or enhance their high scenic quality, recreational value, and fishery and wildlife habitat, while preserving their largely undeveloped character and allowing continuing agricultural uses.

² Those designated areas of a scenic waterway where density of structures or other developments already exist and precludes application of a more restrictive classification.

³ Those designated scenic waterways that are readily accessible by road or railroad, that allow a wide range of compatible, river-oriented, public, outdoor-recreation opportunities, to the extent that these do not substantially

impair the natural beauty of the scenic waterway or diminish its aesthetic, fish and wildlife, scientific, and recreational values.

⁴Those designated scenic waterways that are generally inaccessible except by trail or the river, with related adjacent lands and shorelines essentially primitive. These classified scenic waterways will be administered to preserve their natural, wild, and primitive condition, essentially unaltered by the effects of humans, while allowing compatible recreational uses, other compatible existing uses, and protection of fish and wildlife.

4.12.1 Ecosystem Services

The Wild and Scenic Deschutes River provides the following ecosystem service:

Cultural service, Culturally important natural areas (Figure 4-1 [E5]): People's values for natural areas may arise from personal use (i.e., enjoying the area for recreation, scenic quality, or the environmental value it provides), personal beliefs and moral ethics (i.e., believe protecting a natural area is the right thing to do), altruism (i.e., believing a resource should be protected so that others can use it or benefit from it), and/or a desire to bequest the resource (i.e., believing a resource should be protected for future generations). Similar to the conservation of special status species, to many residents of Central Oregon, the conservation of the Deschutes River has come to represent the restoration of the Deschutes River ecosystem.

5 Alternatives

5.1 Formulation Process

The Preliminary Investigative Report (PIR) published during scoping considered multiple alternatives. The formulation of alternatives followed the CEQ's regulations for implementing NEPA and numerous USDA-NRCS watershed planning policies. Scoping comments were also incorporated into the formulation process of alternatives.

When formulating an alternative, it was first determined whether the alternative met the project purpose and need (Section 2). The alternative was further analyzed for four criteria: completeness, effectiveness, efficiency, and acceptability (NRCS 2017; Appendix D.2). The alternatives of conversion to dryland farming, fallowing farm fields, voluntary duty reduction, partial use of groundwater, and on-farm efficiency upgrades were initially considered during formulation but were eliminated from further analysis because they did not meet the formulation criteria. Appendix D.2 provides further description of these alternatives eliminated during formulation.

5.2 Alternative Eliminated from Detailed Study

The following subsection describes an alternative that met the formulation criteria but was not analyzed in detail as a viable alternative after further consideration.¹⁵

5.2.1 Canal Lining

Under the canal lining alternative, the bottom and sides of 12.2 miles of the open Main Canal would be covered with a geotextile liner and shotcrete to prevent water from seeping into the underlying soils and rock. This alternative would require sub-grade preparation, geotextile liner installation, and application of a layer of shotcrete to protect the geotextile liner.

Lining would increase water velocity in the canal because the shotcrete cover is a smoother surface than the existing underlying rock. This makes the sides of the canal slippery and more difficult for anyone who might accidentally fall in the water to be able to climb out. Fences would be installed along the length of the canal to prevent public access to the channel in order to increase public safety and reduce District liability. These fences would be chosen to prevent the public from nearing the edge or entering the channel and would be standard chain link with a 3-wire barbed wire cap per NRCS guidelines. In channels deeper than 2.5 feet, safety ladders would be installed every 750 feet to provide the opportunity for human and animal escape.

The canal lining alternative would meet the project purpose of conserving water and improving public safety. Lining would reduce water loss from seepage by up to 29.3 cfs during the irrigation season (9,473 acre-feet annually), and fences and ladders would increase public safety. Water loss in

¹⁵ Alternatives that do not address the purpose and need for action, do not achieve the Federal Objective (Section 2) and Guiding Principles (Appendix E.8), or become unreasonable because of cost, logistics, existing technology, or environmental reasons may be removed from consideration (NWPM 501.37; NRCS 2015a; NRCS 2017).

an open, lined system is estimated to be 10 percent based on studies of canal lining (Swihart and Haynes 2002). Lined canals, however, are vulnerable to tears or cracks in the lining; seepage from torn or cracked lined canals is similar to that from unlined canals.

Canal lining has a varying lifespan and can require extensive maintenance to continue operating at high efficiency (Swihart and Haynes 2002). Canal lining may be less expensive than piping to implement in its first installation cycle; however, the increased annual maintenance costs and replacement costs cause canal lining to exceed the cost of piping over a 100-year period.

In cooperation with the Bureau of Reclamation (Reclamation), the District installed ten 500-foot long sections of different lining technologies in 1991 and 1992 as part of the Deschutes Canal-Lining Demonstration Project (Swihart and Haynes 2002). Currently, 29 years after installation, most of the lining sections are degraded and in poor condition. There is widespread cracking in the shotcrete and holes in the lining where silt has collected, forcing the lining upward and impeding water flow in the canal.

The capital costs of canal lining were estimated based on the size of the existing open canal. Annual operating costs associated with canal lining were estimated based on AID's current operating budget, with a 25 percent increase in equipment, maintenance, and labor costs due to the relatively fragile nature of a lined canal compared to an unlined canal. Assuming a 33-year design life,¹⁶ the estimated capital costs, replacement costs, and annual O&M costs are \$80,864,000 (2020 dollars) over 100 years. Based on this cost, canal lining was eliminated from further study (see Appendix D.3 and D.4 for cost details).

5.3 Alternatives Description

Of the project alternatives that were considered for AID's Infrastructure Modernization Project, two were selected for further evaluation and are discussed in the following sections. These alternatives include only AID-owned infrastructure.

5.3.1 No Action Alternative (Future without Federal Investment)

Under the No Action Alternative, the District would continue to operate and maintain its existing open canal and pipe system in its current condition. The District anticipates that its aging flume near the diversion will need to be replaced within 15 to 20 years to avoid failure. This alternative assumes that modernization of the rest of the District's system, other than replacement of the flume, would not be reasonably certain to occur. The No Action Alternative is a near-term continuation of the District's standard operating procedures under the HCP requirements. Installation of the flume under the No Action Alternative would cost approximately \$5,265,000.

¹⁶ The design life of canal lining was determined using data from Reclamation (2002) and AID's experience with existing canal lining in the District. To calculate the Canal Lining Alternative costs over 100 years, the canal lining was fully replaced at 33 and 66 years.

The No Action Alternative would not meet the project purpose and need. There would be no improvement to water loss from seepage in District infrastructure, water delivery reliability for patrons, public safety, or streamflow and habitat conditions for fish and aquatic species. Since no water would be conserved or permanently allocated instream, the No Action Alternative would not achieve the Federal Objective to protect the environment. Similarly, the No Action Alternative would not accomplish the Healthy and Resilient Ecosystem Guiding Principle or the Sustainable Economic Development Guiding Principle (NRCS 2017).

5.3.2 Piping Alternative (Future with Federal Investment)

Under the Piping Alternative, federal funding through PL 83-566 would be available and the District would pipe 13.2 miles of their Main Canal (Figure 5-1). Pipe would range in diameter from 48 to 63 inches, and 88 District turnouts would be upgraded to pressurized delivery that would include an accurate meter measurement device (Crew 2017).

The first 450 feet of the existing aerial flume below the District's diversion would be removed and replaced by pipe supports that would hold an elevated pipe. The new supports and pipe would be approximately the same height as the existing aerial flume. The remaining 4,945 feet of flume would be removed, and a pipe would be buried. Because this section of pipe must be level with the aerial section, the pipe would be buried above the existing landscape elevation and would hug the hillside. The buried pipe would be covered with a minimum of 3 to 4 feet of engineered backfill. A new maintenance road would be built on top of the buried pipe.¹⁷

Construction of the Piping Alternative would occur over 7 years. Construction would be during the non-irrigation season (October to April), with construction beginning as early as the 2022 non-irrigation season.

Construction of the Piping Alternative would include mobilization and staging of construction equipment, delivery of pipe to construction areas, excavation of trenches, construction of supports along 450 feet of the existing aerial flume, fusing of pipelines, placement of pipe, compaction of backfill, and restoration and reseeded of the disturbed areas. Pipe installation would require storage areas for pipe, construction equipment, and other materials. Areas that have been previously disturbed and are accessible through existing access routes would be used when possible.

The project area would be accessed from AID's existing maintenance roads. Existing maintenance roads may require some improvements for use during construction. Once the project is complete, fences would be installed across the maintenance road where it intersects public roads. Fences would be chain link with solar powered gates that would prohibit the public from accessing the maintenance road.

Vegetation clearing before construction, vegetation and weed management during construction, and reseeded after construction of AID's ROW and easements would be completed according to AID's current vegetation management practices and NRCS's *Oregon and Washington Guide for Conservation Seedings and Plantings* (NRCS 2000). During construction, vegetation clearing would be minimized to

¹⁷ Funding for the road would be covered by the District, and would be required to meet city, county, and state requirements.

the extent practicable. Trees would only be removed if there were no other alternative to access the construction site or they posed a safety threat to construction crews.

O&M under the Piping Alternative would consist of an ongoing pipe inspection program that would systematically cover the entire system over a period of several years (most likely a 10-year cycle). During the irrigation season from April through October, work would be performed on an as-needed basis. Outside of the irrigation season, AID would perform system component maintenance and/or repairs to District meters, valves, and air and vacuum infrastructure.

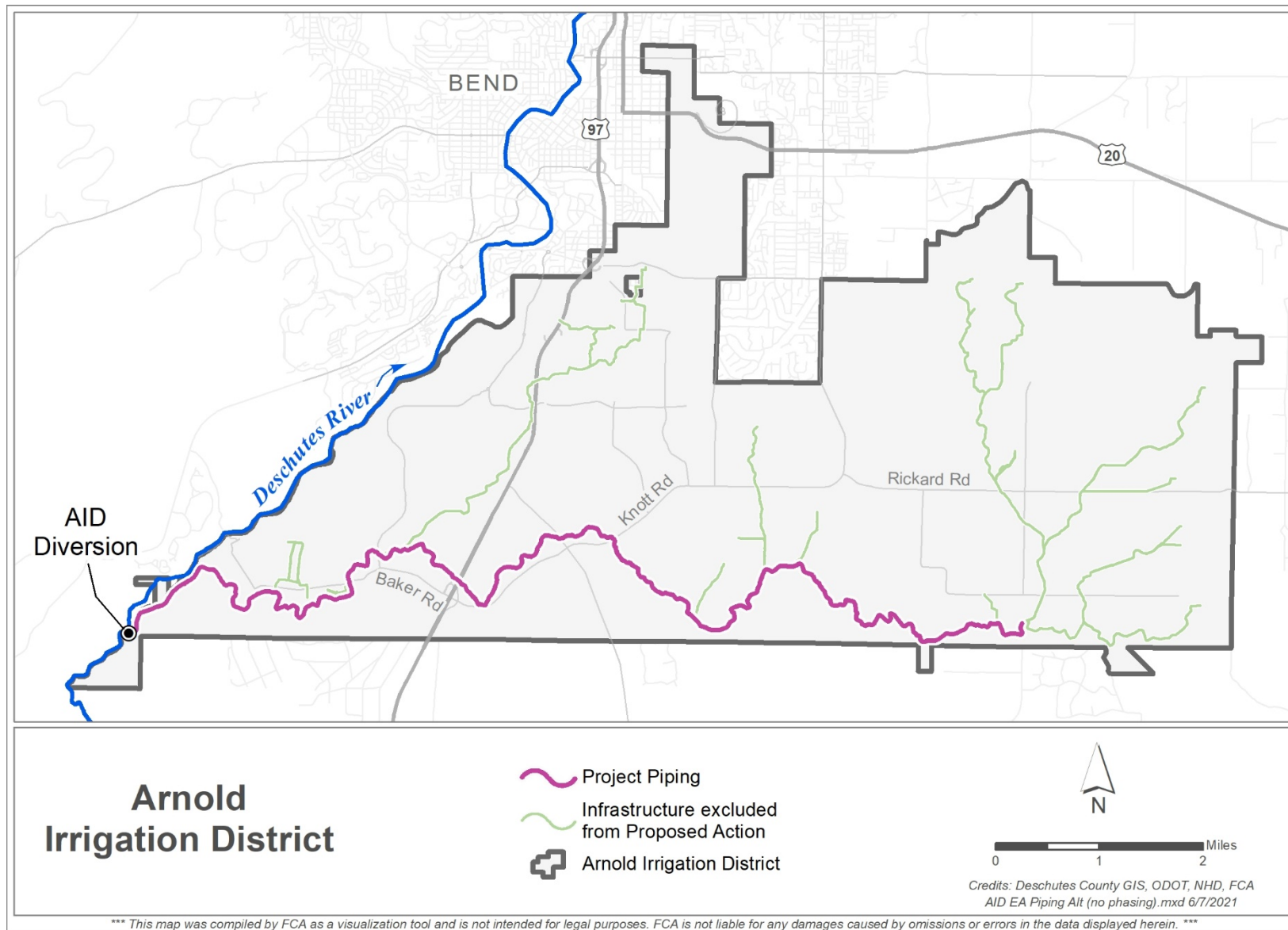


Figure 5-1. Overview of the Piping Alternative for the Arnold Irrigation District Infrastructure Modernization Project.

The Piping Alternative contributes to the project purpose and need as follows:

- **Improve water conservation:** This alternative would reduce water loss from canal seepage and evaporation by an estimated 32.5 cfs (10,526 acre-feet) of water throughout the irrigation season.
- **Increase water delivery reliability to patrons:** A piped system greatly increases conveyance efficiency, allowing patrons to adjust their deliveries to take the amount of water that they need when they need it. This alternative would immediately improve water delivery reliability for the patrons directly served by the Main Canal, including 1,475 acres of irrigated land.
- **Enhance streamflow and habitat conditions for fish and aquatic species:** Following the completion of the project and verification and measurement of the total water savings, AID would pass up to 10,526 acre-feet/year to NUID through the Deschutes River during the irrigation season.¹⁸ In return, NUID would release an equal volume of water minus losses in the Deschutes River between the AID and NUID diversions¹⁹, up to 10,123 acre-feet/year. from Wickiup Reservoir into the Deschutes River during the non-irrigation season (see Section 6.8). Streamflow and habitat conditions along the Deschutes River would benefit from this protected water.
- **Improve public safety:** After completion, the project would improve public safety along 12.2 miles of the Main Canal. All open canal in the project area would be converted to buried pipe. This would decrease the risk of drowning, flooding, and other serious accidents associated with the currently open canal.
- **Reduce O&M costs:** A piped system would eliminate the need to inspect, repair, and remove obstructions from the open Main Canal and flume. The Piping Alternative would also reduce the need for staff to manually adjust diversion amounts within the project area.

The Piping Alternative achieves the Federal Objective to protect the environment by protecting and restoring streamflow in the Deschutes River. By improving operational efficiencies, thereby conserving water and improving water quality in the Deschutes River, the Piping Alternative achieves the Federal Objective and Guiding Principle of sustainable economic development. Lastly, this alternative achieves the Guiding Principles of Healthy and Resilient Ecosystems by contributing to a more resilient ecosystem in the face of changing climate. The estimated project installation cost for the Piping Alternative would be \$38,923,000. With additional project administration and technical assistance costs, the total project cost would be \$42,759,000. Additional information

¹⁸ The District anticipates that 100 percent of the project would be funded through PL 83-566 and other public or public-interest funding sources. If the District were to invest its own funds in the project, the District would pass an amount of conserved water in proportion to the amount of public and public-interest funding to NUID (i.e., if the project was funded with 90 percent public funding, then 90 percent of the conserved water would be passed to NUID). The District would not apply to create new water rights for out-of-stream uses.

¹⁹ Following estimations by OWRD, a 7 percent loss was accounted for in the Deschutes River between the AID and NUID diversions.

regarding the costing and the net present value of the Piping Alternative can be found in Appendix D.3 and D.4.

5.4 Summary and Comparison of Alternatives

Table 5-1 compares the No Action Alternative (Future without Federal Investment) and the Piping Alternative (Future with Federal Investment). The table summarizes measures addressed as well as environmental, social, cultural, and economic effects.

Table 5-1. Summary and Comparison of Alternative Plans.

Item or Concern	No Action Alternative (Future without Federal Investment)	Piping Alternative (Future with Federal Investment)
Major Features	Main Canal remains open	Pipe the Main Canal
Alternative Plans		
Locally Preferred		✓
National Economic Efficiency		✓
Socially Preferred		✓
Environmentally Preferred		✓
Guiding Principles Check marks indicate that the Guiding Principles have been met		
Healthy and Resilient Ecosystems		✓
Sustainable Economic Development		✓
Floodplains		Not Applicable
Public Safety		✓
Environmental Justice		✓
Watershed Approach		✓
Provisioning Services - Trade-Offs		
Irrigation water	No effect. Irrigation water diversions would remain the same.	Piping would help provide more secure and reliable irrigation water for AID patrons. The water saved from the project and passed to NUID would also support agricultural producers in NUID.

Item or Concern	No Action Alternative (Future without Federal Investment)	Piping Alternative (Future with Federal Investment)
Major Features	Main Canal remains open	Pipe the Main Canal
Instream fish species	No effect. Resident and anadromous fish populations would not be affected. Harvest of anadromous fish would continue to be available only when runs are sufficiently large to sustain fishing.	<p>Up to 10,123 acre-feet of water released instream below Wickiup Reservoir into the Deschutes River during the non-irrigation season would have short-term, beneficial effects on resident fish populations and their habitat in Years 4-7 of the HCP.</p> <p>During the irrigation season, up to 10,526 acre-feet of water passed to NUID would secure any long-term, beneficial effects on resident fish populations and their habitats, in the 9.7 miles of the Deschutes River between AID's and NUID's diversions.</p>
Regulating Services - Trade-Offs		
Water quality	No effect. Riverbanks in the winter would continue to be exposed and vulnerable to freeze-thaw cycles that facilitate bank erosion and sediment deposition in the water.	Up to 10,123 acre-feet of water protected instream below Wickiup Reservoir during the non-irrigation season would help improve water quality in the short-term in Years 4-7 of the HCP. The addition of this water would help to alleviate bank erosion and sediment deposition from vulnerable riverbanks.

Item or Concern	No Action Alternative (Future without Federal Investment)	Piping Alternative (Future with Federal Investment)
Major Features	Main Canal remains open	Pipe the Main Canal
Cultural Services - Trade-Offs		
Culturally important species	No effect on habitat supporting populations of threatened fish species. Habitat limitations for culturally significant anadromous fish would continue to affect fishing, community, health, cultural identity, subsistence, and religious tribal values.	Up to 10,123 acre-feet of water protected instream below Wickiup Reservoir during the non-irrigation season would help improve threatened fish and aquatic species habitat and populations in the short-term in Years 4-7 of the HCP. Improving populations would benefit cultural values such as tribal and religious values and bequest values.
Installation Costs		
Federal PL 83-566	\$0	\$27,862,000
Local only or Matching PL 83-566	\$5,265,000	\$14,897,000
Total	\$5,265,000	\$42,759,000
Average Annual Cost		
Installation ¹	\$0	\$987,000
OM&R ²	\$0	\$5,000
Total	\$0	\$992,000
Annual Benefits ³	\$66,000	\$1,801,000
Annual Costs	\$96,000	\$992,000
Annual Net Benefits ⁴	\$-30,000	\$809,000

Item or Concern	No Action Alternative (Future without Federal Investment)	Piping Alternative (Future with Federal Investment)
Major Features	Main Canal remains open	Pipe the Main Canal
<p>¹ The Piping Alternative’s average annual cost is the additional average annual installation costs above the No Action Alternative.</p> <p>² Operation, maintenance, and replacement (OM&R) for the Piping Alternative includes an increase in pumping costs from increased depth to groundwater due to reduced recharge and associated increases in carbon and energy. A decrease in O&M costs of the canals and flume for the Piping Alternative was included in the benefits, rather than the costs.</p> <p>³ Quantified benefits include NUID agricultural damage reduction, reduced O&M costs, instream flow benefits, Oregon spotted frog benefits, avoided damage from failure of the open canal and flume, reduced energy costs from patron irrigation pumping, and reduced carbon outputs.</p> <p>⁴ Annual net benefits shown for the Piping Alternative are the additional net benefits compared to the No Action Alternative.</p>		
Regional Economic Impacts		
Annual Jobs from Recreation	Not applicable	Magnitude/direction of recreation visitation impacts not known, so no benefits quantified.
Local jobs during construction (including direct/indirect/induced)	30 (Average Over 2 Years in Years 15 to 20 during Flume Construction)	80 (Average Over 7 Years of construction from Year 0 to Year 6)
Change in Annual Jobs from agriculture (including direct/indirect/induced)	0	50 (Average over 107-year analysis period)
Beneficial Effects Annualized¹ (2020\$)		
Region	\$100,000	\$1,600,000
Rest of Nation	Some ripple income/employment effects expected, but not estimated.	Some ripple income/employment effects expected, but not estimated.
Adverse Effects Annualized² (2020\$)		
Region	\$0	-\$300,000
Rest of Nation	\$100,000	\$1,100,000

Item or Concern	No Action Alternative (Future without Federal Investment)	Piping Alternative (Future with Federal Investment)
Major Features	Main Canal remains open	Pipe the Main Canal
<p>¹ Beneficial effects include only those related to labor income and do not include the net economic benefits quantified in the NEE. ² Includes only direct costs (no indirect/induced costs are included). Negative adverse effect annualized indicates benefit.</p>		

Notes: AID = Arnold Irrigation District; HCP = Deschutes Basin Habitat Conservation Plan; NEE = National Economic Efficiency; NUID = North Unit Irrigation District; PL = Public Law

6 Environmental Consequences

This section evaluates the environmental consequences of the No Action Alternative and the Piping Alternative. The beneficial and adverse effects of the two alternatives on each resource in Section 4 were evaluated. The intensity of an adverse effect was classified as negligible, minor, moderate, or major. The duration of an effect was classified as temporary, short-term, or long-term. Appendix E.1 presents the intensity threshold matrix used to categorize and define the range of expected effects.

6.1 Cultural Resources

6.1.1 No Action (Future without Federal Investment)

The District's ongoing O&M activities are not expected to affect historic or archaeological resources because these activities are expected to occur in previously disturbed areas.

6.1.2 Piping Alternative

NRCS has initiated consultation with SHPO for the proposed action by providing a project description and a map identifying the project area.

The District has hired a cultural resource specialist to complete surveys for historic properties in the project area. As a part of this process, the surveys will consider alterations to the historic viewshed that would potentially occur due to the proposed project. Once the surveys have been completed, if the cultural resource specialist documents resources eligible for listing in the National Register of Historic Places (NRHP) within the project area, consultation would occur between the District, NRCS, SHPO, THPO, and consulting parties including affiliated tribes to determine the effect on such resources and identify appropriate mitigation if that becomes necessary. Mitigation measures²⁰ would be identified and formalized before construction and completed concurrent with or after construction. The potential cost of mitigation for effects on cultural resources is included in the project cost.

If archaeological resources were inadvertently discovered during construction, an Inadvertent Discovery Plan would be followed. Construction would stop near the discovery; the area would be secured and protected; a professional archaeologist would assess the discovery; consultation with SHPO, THPO, and NRCS cultural resources staff would occur as appropriate; and consulting parties including affiliated tribes and Advisory Council on Historic Preservation (ACHP) would be notified and have the opportunity to comment. Continuation of construction would occur in accordance with applicable guidance and law.

²⁰ Based upon previous mitigation measures implemented by other districts in the Deschutes Basin, if mitigation were to be required, it could include, but not limited to, actions such as working with the historic society to create a board with documentation and photos of the canal. This would be available at the District's office and on the District's website.

6.2 Land Use

6.2.1 No Action (Future without Federal Investment)

The No Action Alternative would have no direct effect on land use within the project area. The Main Canal would continue to operate as an open system. Irrigated agriculture producers would continue to face increasing water supply uncertainty. Ecosystem services of water for irrigation would not be affected (Section 6.8.2).

6.2.2 Piping Alternative

There would be no effect on land use under implementation of the Piping Alternative. Property ownership would not change, and there would be no change to existing land use within or adjacent to the project area. More reliable water delivery would support existing agricultural land uses. Ecosystem services of water for irrigation would be supported through the improvement of delivery infrastructure (Section 6.8.2).

6.3 Public Safety

6.3.1 No Action (Future without Federal Investment)

Under the No Action Alternative, the Main Canal would be left open and the drowning and flooding risk would remain. In some areas, the risk of drowning, flooding, and other serious accidents would increase as urban and suburban areas grow within the District.

6.3.2 Piping Alternative

During construction of the Piping Alternative, public safety would be affected by vehicle and heavy equipment traffic entering and leaving the project area. Construction traffic could interact with motor vehicles, pedestrians, and bicyclists traveling through farmlands and urban and suburban zones along U.S. Highway 97, as well as along county and community roads that intersect the project area. Standard safety protocols and best management practices (BMPs) would be followed during construction to minimize any risk to public safety; therefore, only a minor, short-term effect on public safety is anticipated during construction.

Once fully completed, the Piping Alternative would eliminate the drowning risk from the District's open Main Canal in the project area because it would be converted to buried pipe. This alternative would also decrease any potential flooding risk from canal breaches and sinkholes within the project area, and the durability of the pipe would increase seismic resiliency. The Piping Alternative would therefore result in beneficial effects on public safety because drowning would no longer be possible and there would be a decrease in flooding risk within the project area.

6.4 Socioeconomic Resources

To estimate the total economic effects of the No Action Alternative and Piping Alternative in terms of jobs and income supported, this analysis uses a 2017 IMPLAN economic impact model of Oregon's Deschutes, Jefferson, and Crook counties.²¹

6.4.1 No Action (Future without Federal Investment)

Under the No Action Alternative, in Years 15 to 20 there would be construction expenditures of \$5.3 million to replace the flume that would support construction sector jobs and income, as well as economic ripple effects increasing jobs and income in other economic sectors in Deschutes County. Economic ripple impacts would result from the construction sector spending more on labor, materials, and services, which would spur increased sales and economic activity in other sectors (such as hardware stores and construction equipment businesses supplying construction businesses). Impacts of construction sector spending in these other sectors are known as indirect impacts. As household income rises in construction and indirectly affected economic sectors, household spending will also increase and generate economic activity in such sectors as retail, wholesale trade, personal services industries, and real estate (known as induced impacts). Total job and income impacts of the flume replacement are the sum of the direct impacts (construction sector) and the indirect/induced impacts (in other economic sectors).

The \$5.3 million in construction expenditure is expected to be experienced over 2 years, supporting approximately 30 jobs and \$1.5 million in income in each of those 2 years (annualized over 107 years,²² this equates to approximately \$100,000 in annualized average income benefits). Of these impacts, approximately 20 jobs and \$1.0 million in annual income are in the construction sector (direct impacts), while the remaining 10 jobs and \$500,000 income are in other sectors.

The No Action Alternative would have higher operation, maintenance, and replacement (OM&R) expenses for AID and its patrons associated with higher canal and flume maintenance costs than under the Piping Alternative. These costs are largely labor costs, but there are not anticipated effects on District wages and employment (the District anticipates using re-directing labor resources to other District projects). Changes in OM&R may largely result in a small income transfer between AID patrons, AID staff, and the local construction/repair/supply sectors. As such, there are expected to be limited Regional Economic Development effects of this reduced expenditure (i.e., less than the rounding margin of error), so effects are not quantified in this Regional Economic Development analysis.

²¹ Total construction expenditures were modeled in IMPLAN Construction Sector 57 (IMPLAN 2017), construction of new commercial structures, including farm structures.

²² Note that each project phase has a 100-year life, but since construction takes 7 years, the analysis period is 107 years.

6.4.2 Piping Alternative

Implementation of the Piping Alternative would have a beneficial effect on employment and income in Deschutes County from construction activities, and a beneficial effect on agricultural production and related farm household income in the county.

6.4.2.1 Regional Economic Development

The Piping Alternative construction expenditures of \$42.8 million would support construction sector jobs and income, as well as economic ripple effects increasing jobs and income in other economic sectors in Deschutes County. The \$42.8 million in construction expenditure is spread over 7 years, supporting approximately 80 jobs and \$3.6 million in average annual income over the 7-year construction period. Of these impacts, approximately 50 jobs and \$2.5 million in annual income are in the construction sector (direct impacts) while the remaining 30 jobs and \$1.1 million income are in other sectors. When the \$3.6 million is annualized over the 107-year period analysis of the proposed project this equates to approximately \$600,000 in annualized average income benefits.

Water conserved through piping would be passed on to NUID, where it would decrease agricultural damages associated with irrigation water shortages beginning in 2028.²³ Water conservation under the Piping Alternative is expected to enhance agricultural productivity in NUID. When annualized over the 107-year period on analysis of the project, the regional economic effects in Jefferson County and neighboring Crook and Deschutes counties are estimated at approximately 50 jobs and \$1 million in income annually.

Flume replacement under the Piping Alternative would also safeguard agricultural productivity in AID, as flume failure may result in loss of one irrigation season. However, after taking into account the probability of a flume failure, the annualized benefit is fairly small (less than \$100,000 gross revenue change), the effect on regional economic development on an annualized basis is also quite small (less than rounding error) and is not quantified.

Together, the estimated annualized agricultural and construction benefits to the region would be \$1.6 million over the 107-year period of analysis of the project.

6.5 Soils

6.5.1 No Action (Future without Federal Investment)

Under the No Action Alternative, ongoing erosion of the open canal and maintenance along the District's irrigation system would have minor effects on soils. Continued operation of the District's system would have no effects on prime farmlands.

6.5.2 Piping Alternative

Under the Piping Alternative, soils would be disturbed, vegetation would be cleared, and backfilling and grading would occur in the project area. Clearing, compaction, and construction would increase

²³ Agricultural damages would decrease starting in 2028 due to an increase in HCP base instream flow requirements.

soil erosion and sedimentation potential. During construction, soils adjacent to the canal and flume would be impacted due to equipment access and staging. Excavation for pipe placement would occur primarily in the existing canal and along the existing flume.

BMPs would be implemented throughout the project area to minimize erosion and contain runoff onsite. These could include the installation of silt fencing, straw bales, sequestering of any and all concrete placements and concrete truck cleanouts, and limiting equipment access to existing roads except for strategic access points. To the extent practical, the upper 2-feet of surface materials and rock would be stored beside the construction impact areas and replaced upon the completion of construction. Existing maintenance roads within the District's ROW, and easements would provide access to the project area. After construction, disturbed soils would be re-contoured and reseeded with a mix of native grasses and forbs in consultation with NRCS.

Overall, minor, short-term effects on soils are anticipated because BMPs would be in place, effects would be localized, and effects would only occur during construction. Over the long-term, soil erosion would be reduced where buried pipeline would replace open canal.

6.5.2.1 Farmland Classification

No long-term effect would be expected to any federal or state-level farmland designations. Minor, temporary effects on limited amounts of agriculturally important soils would be expected during construction, but adherence to BMPs would minimize these effects. There would be a beneficial effect on farmlands due to improved irrigation water delivery reliability.

6.6 Vegetation

6.6.1 No Action (Future without Federal Investment)

Under the No Action Alternative, vegetation associated with the open irrigation canal would persist and adjacent native upland vegetation would remain in its current condition.

6.6.2 Piping Alternative

6.6.2.1 General Vegetation

Construction of the Piping Alternative would involve trenching for pipe placement primarily in the existing canal, disturbance of lands adjacent to the canal for construction equipment access, and the use of existing ROW and easements for moving and staging construction equipment and materials.

During construction, existing maintenance roads within the ROW and easements would provide access to the project area. Selection of construction areas adjacent to the canal would consider existing vegetation and avoid mature trees to the extent practicable.

During construction within the project area, herbaceous, shrub, and woody vegetation along the canal and turnouts would be disturbed through activities such as clearing, crushing, and digging.

After construction, the project area would be recontoured and planted with a seed mix of native grasses and forbs (Figure 6-1 and Figure 6-2). Planting would be done in consultation with NRCS. Vegetation within the ROW and easements would transition to entirely upland species. Some trees

that are dependent upon the canal for water may not survive construction of the Piping Alternative. Prior experience with piping projects has shown that 70 to 80 percent of the well-established trees within the project area would survive after piping with active irrigation by the property owner (20 to 30 percent of the trees that do not normally survive in such a location without the canal did not survive after piping).



Figure 6-1. A section of nearby Tumalo Irrigation District’s Bend Feed Canal after a piping project.



Source: DRC 2013

Figure 6-2. A section of nearby Tumalo Irrigation District’s Tumalo Feed Canal after piping.

In the long-term, native vegetation would be gained because 12.2 miles of open canal would be piped and then covered with topsoil and seeded. Revegetation practices would follow NRCS's *Oregon and Washington Guide for Conservation Seedings and Plantings* (NRCS 2000). Trees would not be allowed to establish above the buried pipe because roots may interfere with future O&M activities.

Overall, implementation of the Piping Alternative would have a minor, short-term effect on vegetation because disturbance would be localized and occur over a small proportion of the District, and BMPs designed to minimize effects on vegetation, such as revegetating with natural grasses and forbs in consultation with NRCS, would be implemented (BMPs are identified in Section 8.3).

6.6.2.2 Noxious Weeds

During construction, exposed soils would create temporarily susceptible areas where weeds could establish themselves. The movement of construction vehicles could provide opportunities to transport weeds to new locations. During construction, the contractor would use BMPs such as avoiding unnecessary ground disturbances and using erosion control measures that are free of weeds and weed seeds.

After construction, weeds would be managed according to the protocol in NRCS's *Oregon and Washington Guide for Conservation Seedings and Plantings* (NRCS 2000). After construction, the closed system no longer presents opportunities for aquatic noxious weeds to grow or be washed to other areas of the District.

Implementation of the Piping Alternative would have a negligible, short-term effect on noxious weeds because the spread of noxious weeds during construction would be controlled through BMPs. Over the long-term, there would be a beneficial effect because the conversion to a piped system would reduce the spread of noxious weeds through the open canal system.

6.7 Visual Resources

6.7.1 No Action (Future without Federal Investment)

Under the No Action Alternative, there would be no effect on visual resources.

6.7.2 Piping Alternative

6.7.2.1 Canal Project Area and Adjacent Lands

Under the Piping Alternative, construction activities including use of heavy equipment and pipe laying would be visible to residents and motorists adjacent to the project area. In residential areas where the open canal is adjacent to the backyards of houses, construction activities would be temporarily pronounced but minimized by taking place during daytime hours and through other BMPs listed in Section 8.3. Construction activities would be less pronounced in the segments of the project area that pass through agricultural land because there are fewer residences with a direct view of the canal. Vegetation would be cleared within the project area in some areas where pipe is installed or access for construction equipment is necessary. It is not expected that landscaping would be disturbed outside of AID's ROW or easements.

Disturbance to existing mature trees would be minimized to the extent possible. Trees growing along the edge of the open canal would only be removed if they posed a safety risk to crews working within the project area. There would be minor, short-term effects on visual resources because the construction activities would draw attention to the setting. However, similar large equipment is used for canal maintenance, and is therefore a common feature in the landscape. Construction would be scheduled in the winter during daytime hours, and the BMPs discussed in Section 8.3 would further minimize any visual disruptions.

Pipelines would be buried underground and would not be visible after construction. In most cases, the top of pipes would be placed at grade. After construction, areas adjacent to the canal would be restored to near-prior contours and the area over the pipe would be graded to blend with the remainder of the ROW and surrounding landscape. Disturbed areas, including the newly buried pipes, would be planted with a seed mix of native grasses and forbs in consultation with NRCS.

The view of the project area would change from an open canal (with or without water depending on the season) to a corridor of native upland vegetation. Figure 6-1 and Figure 6-2 show examples of revegetated corridors in neighboring districts. In areas where it would be necessary to clear trees, there would be a permanent decrease in the number and density of trees, which would have a long-term effect on the visual experience for property owners. The visual change for property owners was not monetized due to insufficient data; further discussion can be found in Appendix D.1.1.4.3.

Overall, the Piping Alternative would have a minor, long-term effect on visual resources because the effect would be localized, and the revegetated corridor would blend in with the existing landscape following revegetation.

6.7.2.2 Flume Project Area and Adjacent Lands

Under the Piping Alternative, construction activities along the flume section of the project area would be visible to private residences adjacent to the flume and anyone using the river or hiking on the opposite side of the river. Construction would be done during the non-irrigation season and primarily on a weekday when there would be fewer people using the river or hiking, therefore minimizing the temporary effects.

The first 450 feet of the existing aerial flume would be removed and replaced by supports that would hold a pipe elevated above the ground. Figure 6-3 shows a preliminary example of what the proposed aerial pipe could look like. The new supports and pipe would be approximately the same height as the existing flume and are not expected to have high levels of glare or reflection. Although the new materials would be different, the new elevated pipe would have a similar design and contrast to the existing landscape as the existing flume.

The remaining 4,945 feet of flume would be removed, and a pipe would be buried. Because this section must be level with the aerial section, the pipe would be buried above the elevation of the existing landscape and would hug the hillside. A new maintenance road would be built on top of the buried pipe. The change from flume to buried pipe would be an apparent change; however, the buried pipe would blend with the existing landscape and the change would be minimized through design measures such as following the contours of the hillside.

The presence of vegetation along the maintenance road and aerial pipe section would provide a partial screening effect and help break up the visual impact of a maintenance road and aerial pipe as a linear feature. Additionally, since the river is lower than the road, users on the river would be looking at an upward angled perspective that would preclude users from actually seeing the roadbed, further diminishing the visual impact to recreationalists using the river.

Section 8.3 provides information on other minimization that would be incorporated. Due to the similar design of the new aerial pipe to the existing flume, the unobtrusive appearance of the buried sections, and because the maintenance road would be set back from the river at a higher elevation and partially screened by vegetation, the visual effect along the flume section of the project is considered minor.



Source: McAdams 2020

Figure 6-3. A preliminary example of the proposed aerial pipe section of the flume (approximately 450 feet long). The design and materials would be decided closer to implementation.

6.8 Water Resources

6.8.1 No Action (Future without Federal Investment)

6.8.1.1 Water Rights

Under the No Action Alternative, AID would maintain its water rights. A portion of the water diverted at the AID diversion would continue to seep into the ground before reaching any farms. Concerns regarding water availability from effects of climate change would not be addressed. Concerns regarding water availability for agriculture in NUID would not be addressed.

6.8.1.2 Surface Water Hydrology

The No Action Alternative would not be reasonably certain to convert the District's open Main Canal to a modernized system. There would be no effect on water resources in waterbodies associated with District Operations (Table 4-3) as the District would continue to divert water in volumes that calculate for water loss due to seepage and evaporation. No additional water would be available to NUID.

6.8.1.3 Surface Water Quality

There would be no effect on surface water quality in the waterbodies associated with District operations (Table 4-3). The Deschutes River would continue to be included on Oregon's 303(d) list for not meeting temperature, dissolved oxygen, pH, sedimentation, turbidity, and/or chlorophyll a water quality standards (Table 4-4).

6.8.1.4 Groundwater

There would be no effect on groundwater in the planning area or the upper Deschutes Basin. Approximately 10,526 acre-feet of water would continue to seep from the Main Canal annually into the surrounding area.

6.8.1.5 Ecosystem Services

The No Action Alternative would not affect ecosystem services associated with water resources.

Provisioning service, Water available for irrigation (Figure 4-1 [E1]): Under the No Action Alternative, there would be no effect on irrigation water because the amount of irrigation water diverted from the Deschutes River by the District would largely remain the same.

Regulating service, Water quality (Figure 4-1 [E3]): Under the No Action Alternative, the quality of water remaining instream during the irrigation season downstream of the District's diversion would not be affected. Instream water would continue to be warmer than state standards. During the non-irrigation season, riverbanks would continue to be exposed and vulnerable to freeze-thaw cycles that increase bank erosion and sediment deposition.

6.8.2 Piping Alternative

6.8.2.1 Water Rights

AID's water right currently allows it to divert up to 150 cfs, and this rate exceeds AID's historical diversion rates. To reduce effects on junior water right holders, AID would voluntarily reduce this maximum rate and identify 120 cfs as the District's pre-project diversion rate for the purposes of any water rights administrative processes.

Following construction of each phase, AID would reduce its diversion by the amount of water saved (up to 10,526 acre-feet per year). AID would bypass this water in the Deschutes River for diversion by NUID. Due to seepage losses in the Deschutes River between AID and NUID's diversions,²⁴ there would be 10,123 acre-feet of water available for NUID to divert annually. This additional water would assist NUID in fulfilling its patrons' existing water rights throughout the irrigation season. No effect would occur to AID patrons' certificated rate and duty. This alternative would reduce NUID patron's dependence on water stored in Wickiup Reservoir to fulfill their water rights. Following the completion of each phase, AID would work with OWRD and its partners to verify and measure all water savings prior to creating any instream water leases.

²⁴ Following estimates by OWRD, a 7 percent loss was accounted for in the Deschutes River between the AID and NUID diversions.

Based on AID's historical practices, AID only diverts the water that patrons need. Following project implementation, the District's conveyance system would be more efficient and they would decrease their diversion rate proportionally to the amount of water being saved; therefore, any water that the District does not divert would remain in the Deschutes River and would be available for junior water right holders, including the Deschutes River itself.

Protecting Water Released by NUID to the Deschutes River

Following the completion of each phase, NUID would legally protect the water released from Wickiup Reservoir through an instream lease under Oregon water law (ORS 537.348 [2] and OAR 690-077). The water leased instream would retain the same priority date as the originating water right (Certificate 51229). The instream lease would protect water in the Deschutes River downstream from Wickiup Reservoir during the non-irrigation season (i.e., in the late fall, winter, and early spring). Once an instream lease was approved by OWRD, the leased portion of NUID's water right would be unavailable for use by NUID or its patrons.

Oregon statute allows for NUID's storage water rights to be permanently transferred instream (ORS 537.348). However, OARs need further clarity to allow these storage water rights to be permanently transferred instream. An agreement would be established specifying that these instream leases would be renewed in perpetuity or until the State of Oregon provided the clarity needed for a permanent change.

Water released by NUID during the non-irrigation season would be in addition to the HCP minimum winter flow target of 100 cfs²⁵ in the Deschutes River downstream from Wickiup Reservoir. This additional flow would be beneficial to the Deschutes River until Year 8 of the HCP (January 2028) when the minimum winter flow target is increased to 300 cfs.

6.8.2.2 Surface Water Hydrology and Water Quality

Effects on individual reaches are identified below.

6.8.2.2.1 CRANE PRAIRIE RESERVOIR

Surface Water Hydrology

Implementation of the Piping Alternative would have no effect on Crane Prairie Reservoir.

Surface Water Quality

Implementation of the Piping Alternative would have no effect on water quality in Crane Prairie Reservoir.

²⁵ Other water conservation projects are occurring in the Deschutes Basin that will also allocate water instream in addition to the HCP minimum flow target of 100 cfs. These cumulative effects are discussed in Section 6.13.

6.8.2.2.2 WICKIUP RESERVOIR

Surface Water Hydrology

Up to 10,123 acre-feet of stored water in the reservoir would be dedicated to and released for instream use, which is about 5 percent of the reservoir's capacity.²⁶ The Piping Alternative would have negligible, long-term effects on Wickiup Reservoir because there would only be a slight change in active storage volume that would be barely at the level of detection with no perceptible impacts to the Reservoir.

Surface Water Quality

The Piping Alternative would result in negligible short-term effects on water quality in Wickiup Reservoir as storage volumes are reduced throughout the irrigation season and reservoir water temperatures increase in late summer and early fall. These effects could include decreased oxygen levels and increased phosphorus levels, which in turn could increase intensity and duration of algae and cyanobacteria blooms in the reservoir during the summer and into early fall (AID et al. 2020). These effects are consistent with effects from the implementation of the HCP.

6.8.2.2.3 DESCHUTES RIVER FROM WICKIUP RESERVOIR (RM 226.8) TO THE ARNOLD CANAL DIVERSION (RM 174.5)

Surface Water Hydrology

The Piping Alternative would have short-term beneficial effects in this reach of the Deschutes River during the non-irrigation season and no effect in this reach during the irrigation season. This alternative would increase streamflow in the Deschutes River during the non-irrigation season by 33.8²⁷ cfs below Wickiup Reservoir and by 29.6²⁸ cfs at Benham Falls. This additional flow would be beneficial to the Deschutes River until Year 8 of the HCP (January 2028) when the minimum winter flow target is increased to 300 cfs. After January 2028, there would be no effect on this reach; the water from this project would be released as part of the 300 cfs maintained instream under the HCP.

The Piping Alternative would have no effect in this reach during the irrigation season as releases from Wickiup Reservoir would continue as it has historically to meet patron demand in both AID and NUID.

²⁶ Wickiup Reservoir has an active storage capacity of 200,000 acre-feet.

²⁷ If spread evenly across the non-irrigation season (November 1 to March 31), 10,123 acre-feet of water would allow for 33.8 cfs to be released from Wickiup Reservoir. Due to the geology of the upper Deschutes Basin, OWRD accounts for water losses in certain river reaches and is described in these sections with said adjustments incorporated into the flow rates.

²⁸ Losses were accounted for along the Deschutes River following OWRD's estimations. These losses include a 12.5 percent channel loss from Wickiup Reservoir to Benham Falls and a 7 percent channel loss from Benham Falls to the City of Bend.

Surface Water Quality

The proposed action would increase late fall, winter, and early spring streamflow in the Deschutes River from Wickiup Reservoir (RM 226.8) to the Arnold Canal Diversion (RM 174.5) until Year 8 of the HCP (January 2028), when the minimum winter flow target will be increased to 300 cfs. Water quality in the Deschutes River downstream of Wickiup Reservoir is greatly influenced by water quality in Wickiup Reservoir itself, and higher winter flows are typically associated with improved water quality. However, as storage volumes in Wickiup Reservoir are reduced throughout the irrigation season and reservoir water temperatures increase, late summer and early fall reservoir releases would result in reduced water quality in the Deschutes River below Wickiup Reservoir (AID et al. 2020). These effects would be short-term (until Year 8 of the HCP [January 2028]) and would diminish further downstream as a result from tributary inflows and groundwater discharge (AID et al. 2020). Following Year 8, this additional water would be used to meet the minimum streamflow targets and the proposed action would have no effect on surface water quality in this reach.

6.8.2.2.4 DESCHUTES RIVER FROM ARNOLD CANAL DIVERSION (RM 174.5) TO NORTH CANAL DAM (RM 164.8)

Surface Water Hydrology

The Piping Alternative would have short-term beneficial effects in this reach of the Deschutes River during the non-irrigation season and long-term beneficial effects during the irrigation season. This alternative would increase streamflow in the Deschutes River during the non-irrigation season by 27.5²⁸ cfs at North Canal Dam. This additional flow would be beneficial to the Deschutes River until Year 8 of the HCP (January 2028) when the minimum winter flow target is increased to 300 cfs. After January 2028, there would be no effect on this reach during the non-irrigation season; the water from this project would be released as part of the 300 cfs maintained instream under the HCP.

During the irrigation season, 100 percent of the water saved by the project, up to 32.5 cfs, would be allowed to pass AID's diversion, increasing flows in this reach. This water would then be diverted at the NUID diversion (RM 164.8). Increases to streamflow in this reach would be beneficial and long-term.

Surface Water Quality

The Piping Alternative would increase late fall, winter, and early spring streamflow in the Deschutes River from the Arnold Canal Diversion (RM 174.5) to North Canal Dam (RM 164.8) until Year 8 of the HCP (January 2028), when the minimum winter flow target will be increased to 300 cfs. Effects on water quality during the non-irrigation season are the same as those described in Section 6.8.2.2.3.

The Piping Alternative would have long-term benefits to water quality during the irrigation season as the District increases streamflow in this reach by up to 32.5 cfs.

6.8.2.2.5 DESCHUTES RIVER FROM NORTH CANAL DAM (RM 164.8) TO LAKE BILLY CHINOOK (RM 120.0)

Surface Water Hydrology

The Piping Alternative would have short-term beneficial effects in this reach of the Deschutes River during the non-irrigation season and no effect during the irrigation season. This alternative would increase streamflow in the Deschutes River during the non-irrigation season by 27.5²⁸ cfs at North Canal Dam. This additional flow would be beneficial to the Deschutes River until Year 8 of the HCP (January 2028) when the minimum winter flow target is increased to 300 cfs. After January 2028, there would be no effect on this reach during the non-irrigation season; the water from this project would be released as part of the 300 cfs maintained instream under the HCP.

The Piping Alternative would have no effect in this reach of the Deschutes River, as the additional streamflow allowed to pass AID's diversion would be diverted at the NUID diversion at North Canal Dam (RM 164.8).

ODFW has a pending instream water right for this reach, which is usually met during the non-irrigation season.

Surface Water Quality

The Piping Alternative would increase late fall, winter, and early spring streamflow in the Deschutes River from the Arnold Canal Diversion (RM 174.5) to North Canal Dam (RM 164.8) until Year 8 of the HCP (January 2028), when the minimum winter flow target will be increased to 300 cfs. Effects on water quality during the non-irrigation season are the same as those described in Section 6.8.2.2.3.

The Piping Alternative would have no effect on water quality in this reach during the irrigation season as the additional streamflow allowed to pass AID's diversion would be diverted at the NUID diversion at North Canal Dam (RM 164.8).

6.8.2.2.6 DRAINAGE COURSES

Although the District does not allow its canal and lateral system to be intentionally utilized for stormwater management,²⁹ the Piping Alternative would eliminate the opportunity for the canals to be indirectly used for stormwater conveyance or disposal. The conversion of the open canal to a piped system would return the landscape along the canal to its original grade and to the natural surface runoff patterns that existed prior to the presence of the open canal. Coordination with the District and landowners directly down gradient of the new pipelines would occur to mitigate potential unintended consequences. The elimination of the proposed canal section as a drainage course would result in a minor, long-term adverse effect on drainage courses. There would be no effect on current drainage courses along the flume.

²⁹ The District does not allow for its canal and lateral system to be used for stormwater management in effort to avoid risk of contaminating irrigation water with potential stormwater pollutants.

6.8.2.2.7 IRRIGATION WATER QUALITY SUPPLIED TO PATRONS

The Piping Alternative would have long-term beneficial effects on the water quality of irrigation water delivered to AID patrons. Piping the Main Canal prevents contaminants such as herbicides, pesticides, animal waste, and stormwater runoff from entering the water supply for AID patrons down gradient.

6.8.2.3 Groundwater

No groundwater resources would be extracted or consumptively used as part of this project; however, piping the Main Canal would affect groundwater hydrology associated with canal seepage. Canal piping would reduce seepage in this area by up to 10,526 acre-feet annually during the irrigation season.

On average, for this part of the Deschutes Basin, this decrease in recharge translates into a decreased groundwater elevation of approximately 0.028 foot annually (see Appendix D 1.1.4.1 for calculation details). An important caveat is that localized effects on groundwater would differ throughout the area. Over the course of 107 years (the life of the project plus the construction period), this annual drop results in a cumulative decreased average groundwater elevation of 2.8 feet. These effects would be most prominent at shallow depths closest to canals and attenuate with increasing depth (Gannett and Lite 2013).

As described in Section 4.8.5, changes in canal seepage account for only a small portion of historical changes in groundwater recharge in the area. Climate remains the primary factor affecting groundwater levels in the region. The U.S. Geological Survey estimated that the combined effects of climate and groundwater pumping accounted for approximately 90 percent of the observed decrease in groundwater levels in the region and that canal piping and lining accounted for 10 percent of that observed decrease (Gannett and Lite 2013).

A National Economic Efficiency (NEE) benefit-cost analysis has been completed to evaluate the benefits and costs of the Piping Alternative (Section 8.10; Appendix D.1). The cost of groundwater recharge was included in this analysis. The analysis combines the decreased groundwater elevation for each year in the 107-year analysis period with the estimated volume of groundwater pumping to estimate the total increased costs of groundwater pumping in the basin over time (Sussman et al. 2017).

Based on the measurable, but small amount of reduced canal recharge relative to climate factors and groundwater pumping, the proposed action would have a minor, long-term effect on groundwater in the upper Deschutes Basin.

6.8.2.4 Ecosystem Services

The Piping Alternative would affect ecosystem services provided by water flowing through the Deschutes River in the following ways.

Provisioning service, Water available for irrigation (Figure 4-1 [E1]): Implementation of the Piping Alternative would have a beneficial effect on irrigation water deliveries. Water conveyance through

closed pipe would improve efficiency by eliminating water loss due to seepage and evaporation, which in turn would allow the District to deliver adequate and reliable water to patrons while diverting less water from the Deschutes River. By passing the District's conserved water to NUID during the irrigation season, NUID would have access to more irrigation water to help fulfill its patrons' irrigation needs. Modernizing AID irrigation infrastructure would enable the District to be more resilient to environmental changes and maximize the efficiency of water conveyance.

Regulating service, Water quality (Figure 4-1 [E3]): Following implementation of the Piping Alternative, NUID would release an equivalent volume of water in the non-irrigation season that AID saved through modernization and passed to NUID. The addition of water instream during the non-irrigation season would help alleviate bank erosion and sediment deposition that occurs because of exposed riverbank vulnerable to freeze-thaw cycles.

6.9 Fish and Aquatic Resources

6.9.1 No Action (Future without Federal Investment)

6.9.1.1 General Fish and Aquatic Species

Under the No Action Alternative, AID's Main Canal would remain open and there would be no effect on fish and aquatic species in the area affected by District operations. The District would continue to divert water from the Deschutes River for consumptive use at the current rate. The Main Canal would continue to leak water. This would continue to alter the hydrologic pattern of the Deschutes River streamflow similar to the last 50 years. The same amount of water would continue to be stored in Crane Prairie Reservoir and routed along the Deschutes River to the AID diversion. The low streamflow in the Deschutes River downstream of the AID diversion during the irrigation season would continue to reduce the potential fish habitat and compromise water quality for fish and aquatic species.

6.9.1.2 Federally Listed Fish and Aquatic Species

There would be no effect on habitat supporting the Oregon spotted frog under the No Action Alternative. Because bull trout and steelhead populations reside in downstream waterbodies where instream flow changes would have little to no effect on habitat (RM 132.0 to Lake Billy Chinook, Section 4.9.2), the habitat supporting these populations would likely not change from its current state.

6.9.1.3 Ecosystem Services

The No Action Alternative would have no effect on fish and aquatic resources related ecosystem services.

Provisioning service, Fish populations (Figure 4-1 [E2]): Harvest of resident and anadromous fish would not be affected. Anadromous fish would be available when runs are sufficiently large to sustain fishing. Although ODFW and CTWS are working to restore anadromous fisheries in the Basin, the pace is likely to be slow and limited to available habitat instream.

Cultural service, Culturally important species (Figure 4-1 [E4]): There would be no effect on habitat supporting populations of culturally important fish species. Habitat limitations for culturally significant anadromous fish would continue to affect fishing, community, health, cultural identity, subsistence, and religious tribal values.

6.9.2 Piping Alternative

6.9.2.1 General Fish Species

During and following project construction, there would be no direct or indirect effects on any fish in the project area. However, common aquatic species such as western toad, Pacific treefrog, and long-toed salamander have been known to use open canals. Implementation of the Piping Alternative would have a direct effect on these species during construction because habitat in the open canal would be lost. However, the habitat is low quality and is not considered critical to the long-term survival of these species (S. Wray, personal communication, November 17, 2017). Further, the invasive bullfrog species that also utilizes open canals would be impacted when they are removed during construction.

During the irrigation season, up to 10,526 acre-feet of water conserved through the District's Piping Alternative (up to 32.5 cfs)³⁰ would pass the District's diversion (RM 174.5) and would be diverted 9.7 miles downstream by NUID (RM 164.8) for consumptive use (Section 6.8.2). The Piping Alternative would secure any beneficial effects that water in this reach provides to fish and aquatic species during the irrigation season. Following implementation, any beneficial effects in this reach would be long-term (Section 6.8.2).

In return for passing the District's conserved water to NUID, NUID would release an equal volume of water, minus losses in the Deschutes River between the AID diversion and the NUID diversion, (up to 10,123 acre-feet) from Wickiup Reservoir into the Deschutes in the non-irrigation season continuing in perpetuity (Section 6.8.2). The effect that this activity would have on fish and aquatic species is evaluated in the context of the HCP requirements adopted December 31, 2020.

In Years 4 through 7 of the HCP (January 2024 through December 2027), any conserved water allocated instream in the Deschutes River below Wickiup during the non-irrigation season would be in addition to the HCP minimum winter flow target of 100 cfs. If the conserved water were allocated at a flat rate for the duration of the non-irrigation season, NUID would release up to 33.8 cfs from Wickiup Reservoir. This action would improve the Deschutes River streamflow regime and water quality, which would have an indirect, beneficial effect on fish and aquatic species and their habitat.

Of the 33.8 cfs³¹ of conserved water released from Wickiup Reservoir into the Deschutes River, 27.5 cfs would pass through North Canal Dam in the Deschutes River (see Section 6.8.2.2) during the non-irrigation season. However, because winter streamflow in this section of the Deschutes River

³⁰ Conserved water would be released incrementally as the project is completed. See Section 6.8.2.2.

³¹ This calculation accounts for water loss along the Deschutes River. According to OWRD, these losses include a 12.5 percent channel loss between Wickiup Reservoir and Benham Falls and a 7 percent channel loss between Benham Falls to the City of Bend.

ranges between 450 and 1,200 cfs due to the contributions of tributaries and natural springs, the addition of 27.5 cfs would not likely affect fish and their habitats.

Beginning in Year 8 of the HCP (January 2028), base instream flow requirements during the non-irrigation season would be increased to 300 cfs. At this point, the allocation of up to 33.8 cfs (10,123 acre-feet) of water into the Deschutes River by NUID as a result of AID's Piping Alternative would act to support the HCP instream flow requirements. No additional effects on fish and aquatic species would be observed.

6.9.2.2 Federally Listed Fish and Aquatic Species

Within the affected area, the federally listed Oregon spotted frog occurs in Crane Prairie Reservoir, Wickiup Reservoir, and the Deschutes River (see Section 4.9.2). Water released from Wickiup Reservoir as a result of the Piping Alternative would increase streamflow during the non-irrigation season (Section 6.8.2.2). In Years 4 through 7 of the HCP, this action would benefit the Oregon spotted frog and its critical habitat in the Deschutes River. All PCEs of the Oregon spotted frog critical habitat would benefit from the Piping Alternative in this reach (Appendix E.5). Beginning in Year 8 of the HCP, the conserved water allocated instream as a result of this Piping Alternative would support the instream flow requirements for restoration and no additional benefits for Oregon spotted frog or critical habitat would be observed.

Construction of the flume is near Oregon spotted frog critical habitat (Appendix E.5; Figure E-1) and may have a temporary effect on habitat (J. O'Reilly, personal communication, April 6, 2020). Early coordination with USFWS is ongoing to determine the degree of effect and identify mitigation measures. Informal consultation regarding Oregon spotted frog will be initiated following the public comment period. USFWS concurrence with a "May Affect-Not Likely to Adversely Affect" determination is anticipated.

Bull trout critical habitat is located within the affected area (Appendix E.5 Figure E-1), and bull trout are known to forage in the Deschutes River from Big Falls (RM 132.0) to Lake Billy Chinook (RM 120.0) during the non-irrigation. In this reach, however, increased streamflow during the non-irrigation season as a result of the Piping Alternative would have no effect on bull trout because the amount of increased streamflow would not be sufficient to produce a discernable effect on bull trout populations or PCEs identified in the critical habitat designations (75 Fed. Reg. 200, 2010). Consequently, NRCS has determined that 1) no effects would occur to federally designated critical habitat for bull trout and 2) Section 7 consultation under the ESA is not warranted for this species. Technical assistance from USFWS provided no additional information that would warrant reconsideration of this determination (P. Lickwar, personal communication, March 10, 2021).

The Middle Columbia River steelhead population can potentially access the Deschutes River as far upstream as Big Falls (RM 132.0; Appendix E.5 Figure E-1). Similar to the effects on bull trout, changes to streamflow or water quality as a result of the Piping Alternative would have no effect on the steelhead population. Because Middle Columbia River steelhead are considered a non-essential experimental population until January 2025. Non-essential experimental populations are treated as "proposed for listing" under Section 10(j) of ESA (76 Fed. Reg. 28715, 2011); because implementation of the Piping Alternative is not likely to jeopardize the continued existence of the

species (76 Fed. Reg. 28715, 2011; 81 Fed. Reg. 33416, 2016; Section 4.9.2; Section 8.6), NRCS has determined that Section 7 consultation with NMFS under ESA is not warranted (Section 8.6).

6.9.2.3 Ecosystem Services

The Piping Alternative would affect the ecosystems services provided by fish and aquatic resources in the following ways.

Provisioning service, Fish populations (Figure 4-1 [E2]): Over the long-term, increased streamflow as a result of the Piping Alternative would improve habitat for resident fish species during the non-irrigation season. Bolstering fish populations may allow more consistent fishing for harvest and consumption.

Cultural service, Culturally important species (Figure 4-1 [E4]): Following the modernization project, up to 33.8 cfs would be allocated instream during the non-irrigation season (Section 6.8.2.2). The allocated water would have a beneficial effect on instream habitat for culturally important fish, which would positively affect Central Oregon community member values and contribute to CTWS goals including enhanced fishing, community, health, cultural identity, subsistence, and religious tribal values.

6.10 Wetlands and Riparian Areas

6.10.1 No Action (Future without Federal Investment)

Under the No Action Alternative, wetland and riparian vegetation associated with the open irrigation canal would persist and, although the canal within the project area is mechanically managed to clear vegetation, seepage supporting wetland and riparian features adjacent to the canal would remain in its current condition.

6.10.2 Piping Alternative

Wetland and Riparian Areas along the Project Area

The Main Canal within the project area is managed mechanically to clear vegetation. NWI³² geographic information systems data (USFWS 2016) was used as a first-step approach in identifying and evaluating potential wetlands in the project area. Through an analysis of NWI data and examining aerial imagery, one site within the project area was identified as a Freshwater Forested/Shrub wetland at the site of the flume along the Deschutes River that could be affected by implementation of the proposed project; however, wetland determinations or delineations have not occurred at this time.

During construction on the flume, there could be potential temporary effects, such as sedimentation from stormwater runoff. Implementation of BMPs such as silt fencing would be utilized to minimize effects.

³² The NWI code uses the Cowardin classification system. For further information about Cowardin classifications, refer to *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979).

Construction would result in the permanent fill of the canal in the project area. Seasonal opportunistic hydrophytic plants that sporadically occur within and directly adjacent to the canal would be removed or buried during excavation, fill, placement of pipe, or other construction activity, and the District would follow appropriate reclamation procedures in order to revegetate disturbed areas as uplands. All wetlands within or adjacent to the project area would be avoided to the extent practicable, and the District would follow appropriate reclamation procedures in order to revegetate disturbed areas.

Generally, project canals and laterals are not considered wetlands or Waters of the United States by state or federal agencies (see Section 4.10); however, prior to project implementation, consultation with ODSL and USACE would occur to determine exemption applicability to canals and laterals in the District.

In locations where piping would occur, seepage losses would be eliminated, potentially limiting the water available to adjacent wetlands if they are dependent upon canal seepage for hydrology. Additionally, wetlands in the project area may provide some wildlife habitat that would be permanently changed to upland areas after project construction.

Because eliminating seepage losses could reduce water availability to wetlands and hydrophytic vegetation occurring in places near or adjacent to the project area, this alternative could have minor, long-term effects on these wetlands and hydrophytic vegetation. Construction along the flume would have minor, short-term effects on wetlands and riparian areas along the Deschutes River. Should it be required, the District would hire a consultant to perform a wetland delineation prior to implementation of the project.

The Piping Alternative would have no effect on excavated water storage ponds that occur adjacent to the project area, and the hydrophytic vegetation along these ponds would not be disturbed.

Wetland and Riparian Areas along Natural Waterbodies Associated with District Operations

As discussed above, construction on the flume would have short-term effects on wetland and riparian areas along the Deschutes River within the project area. Contractors would follow BMPs to minimize effects.

The proposed action would result in slight improvements in water quality and habitat function in the 111.8 miles of natural riverine systems along the Deschutes River downstream of Wickiup Reservoir (RM 238.8) as a result of increased streamflow during the non-irrigation season. Restablishing a more natural hydrologic regime in these reaches could allow the river channel to supply water to wetlands and riparian areas via infiltration through channel banks, thus enhancing wetland and riparian function by facilitating processes such as surface and groundwater exchange as well as physical and chemical transformations, and supporting riparian plant communities. However, these benefits would be short-term and only realized prior to HCP requirements increasing flows to 300 cfs (i.e., in Year 8 following implementation of the HCP).

6.10.2.1 Permitting and Compliance

The construction or maintenance of the irrigation ditches located outside the Waters of the United States are generally exempt from regulation under Section 404(f)(1)(C) of the CWA (USACE and USEPA 2020). Under this exemption, it is expected that no permit would be required for the disturbance to wetlands within AID's existing canal and lateral system. However, coordination and consultation with ODSL and USACE would occur prior to implementation of each site-specific project to ensure the project either meets exemption criteria or that the proper permitting and construction activities are conducted in accordance with the permits' requirements.

EO 11988 requires federal agencies to avoid to the extent possible the long- and short-term effects associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The proposed action would not occur within the 100-year floodplain and, therefore, would have no effect on the floodplain elevation.

6.11 Wildlife Resources

6.11.1 No Action (Future without Federal Investment)

Under the No Action Alternative, no effect on wildlife along the Main Canal is expected because District activities would remain in their current condition.

6.11.2 Piping Alternative

The Main Canal is mechanically managed to clear vegetation; therefore, very little habitat for wildlife exists. During construction, terrestrial wildlife could experience noise disturbance due to heavy equipment operation, habitat removal due to tree cutting and other vegetation removal, or injury due to collision with construction equipment or habitat removal. The canal is located in agricultural areas where heavy equipment use is commonplace; therefore, most wildlife in the area are accustomed to noise and these disturbances are anticipated to be minor.

Wintering or migrating birds would be minimally affected by construction disturbance because they have the flexibility to move away from disturbances to other suitable areas. There would be no expected effect on breeding migratory songbirds or waterbirds as construction activities would occur outside the nesting season.

The District would follow USFWS guidelines to ensure minimal disturbance to bald or golden eagles nesting near the project area. The critical nesting period for bald and golden eagles is January 1 through August 31. A section of the project area near Horse Butte Road and Knott Road is approximately 0.6 mile and 1.9 miles, respectively, from Golden Eagle nesting areas (E. Weidner, personal communication, December 17, 2019). Because of the proximity of the project area to nesting sites, a seasonal restriction for the use of hydraulic hammers is in effect for these segments of the project area. Clearance surveys would be completed prior to implementation, and early coordination with USFWS is ongoing (E. Weidner, personal communication, November 25, 2019).

As the canal is piped and the removal of this water source occurs, the distribution patterns of wildlife within the project area could change. Although some species may use the canal as a water source, the canal can have an adverse effect on wildlife due to risk of drowning and the barrier that it creates to terrestrial movement (Beier et al. 2008). As this alternative would be implemented over time, ungulates and other terrestrial wildlife would have ample time to adjust and find new water sources. Furthermore, this alternative would have no effect on excavated water storage ponds served by the project, and these would still allow for summer drinking water and habitat for wildlife.

Construction activities would cause short-term, negligible effects on wildlife due to increased human presence. Regarding long-term effects, piping of irrigation systems would potentially reduce human presence through the project area, as fewer trips to maintain ditches and headgates would be necessary. This would result in fewer human-wildlife conflicts and improved seclusion for wildlife. In addition, the Piping Alternative could remove barriers to ungulates and other terrestrial wildlife within the project area as the open canal is converted to buried pipelines.

Project implementation would provide increased streamflow in the Deschutes River downstream from Wickiup Dam, and this increased streamflow could enhance riparian habitat. Improved streamflow would provide more consistent access to water for hydrophytic plants (see Section 6.10.2), and this would in turn enhance riparian wildlife habitat. Overall, the Piping Alternative would have a minor, long-term effect on general wildlife in the project area. Unavoidable effects on wildlife would be minimized using BMPs.

6.11.2.1 Threatened and Endangered Species

The Piping Alternative would have no effect on threatened or endangered terrestrial species. As noted in Sections 4.9.2 and 4.9.3, no federally or state-designated fish or aquatic species or federally designated critical habitat occurs within the project area. Effects on federally or state-designated species or federally designated critical habitats within waterbodies affected by District operations are discussed in Section 6.9.2.2.

6.12 Wild and Scenic Rivers

6.12.1 No Action Alternative (Future without Federal Investment)

The No Action Alternative would have no effect on the values that support the designation of Wild and Scenic Rivers or on State Scenic Waterways in the waterbodies associated with District operations. The No Action Alternative would also have no effect on the ORVs listed in Section 4.12.

6.12.1.1 Ecosystem Services

The No Action Alternative would have no effect on ecosystem services provided by the Wild and Scenic Deschutes River resources.

Cultural service, Culturally important natural areas (Figure 4-1 [E5]): There would be no effect on Deschutes River ORVs nor on Central Oregon community member values.

6.12.2 Piping Alternative

Implementation of the Piping Alternative would have no effect on the Wild and Scenic River or State Scenic Waterways designation or the free-flowing condition of the designated reaches downstream from Wickiup Dam (RM 226.8) to Lake Billy Chinook (RM 120.0). However, construction activities would occur along approximately 1.25 mile of the Deschutes River (construction activities begin along RM 174.5) that is designated as both a Wild and Scenic River and a State Scenic Waterway (Figure 6-4). Within this area, all new structures, improvements, and development would comply with the Land Management Rules as described in OAR 736-40-035 and OAR 736-40-040(1)(b)(B). Consultation with Oregon Parks and Recreation Department and USFS will occur prior to finalization of this Plan-EA.

Increased streamflow would be consistent with Wild and Scenic River management goals (U.S. Department of Interior 1992). The proposed action would have beneficial effects on some of the qualities that support these designations. Specifically, any effect of increased streamflow would be an enhancement to fish, recreation, scenery, wildlife, hydrological, and botanical/ecological values.

6.12.2.1 Ecosystem Services

The Piping Alternative would affect the ecosystem services provided by the Wild and Scenic Deschutes River resources in the following way.

Cultural service, Culturally important natural areas (Figure 4-1 [E5]): Following the modernization project, up to 33.8 cfs would be allocated instream during the non-irrigation season (Section 6.8.2.2). The allocated water would have a beneficial effect on several Deschutes River ORVs including fisheries and hydrology (Appendix E.7) and would positively affect Central Oregon community member values.

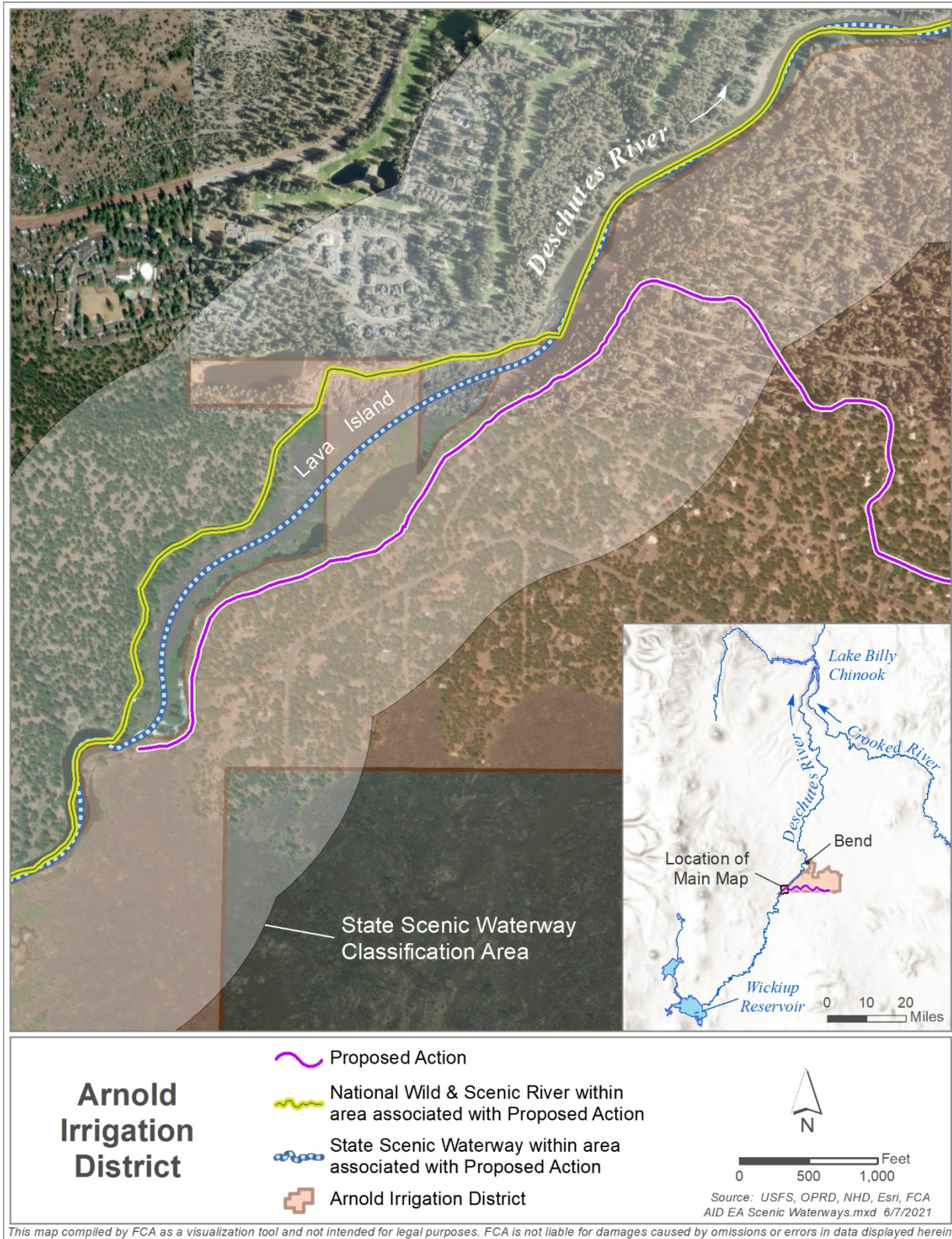


Figure 6-4. Project area within State Scenic and National Wild and Scenic River Boundaries.

6.13 Cumulative Effects

6.13.1 Past Actions

Past actions over the last 120 years that have affected resources in the Deschutes River watershed are generally land development activities that include irrigated agriculture (consisting of canal system construction, previous piping projects, and diversions), urban and suburban development, industrial land and water uses, commercial development, water diversions for non-agricultural uses, and transportation infrastructure. Section 4 describes the nature and extent of these past actions and how they have influenced the existing environment for each resource.

AID's delivery system was constructed between 1907 and 1919 to provide water to surrounding farms and ranches for crops and livestock. Seven other irrigation districts were developed within the Deschutes Basin during the early 20th century, collectively altering the hydrology of the Deschutes River and its tributaries. Over time, there has been increasing pressure to reduce the effects of irrigation needs on the natural water cycle in the Deschutes Basin.

Since the early 1990s, there has been increasing interest in improving instream flows conserving water in the Deschutes River. The District and other Deschutes area irrigation districts have completed various water conservation projects. These recent past efforts have included piping existing irrigation canals, on-farm conservation, water management changes, and changes to crop production, which have resulted in increased streamflow in the Deschutes River (Section 4.8.3) but decreased seepage into the groundwater table (Section 4.8.5).

6.13.2 Current and Reasonably Foreseeable Future Actions

Current actions are those projects, developments, and other actions that are presently underway either because they are under construction or are occurring on an ongoing basis. Reasonably foreseeable future actions generally include those actions formally proposed or planned, or highly likely to occur based on available information. Various sources including local, state, and federal agency websites and city and county staff were consulted to obtain information about current and potential future development in the project area. The following sections describe these current actions and reasonably foreseeable future actions. This list is not comprehensive and other actions may be taking place or may take place in the future.

6.13.2.1 Land Use and Development

Ongoing agricultural activities including farming and grazing in the project area are not expected to change from current conditions. Land use development in the project area would continue to be managed according to the Deschutes County Comprehensive Plan and Deschutes County zoning regulations. Land development activities are expected to continue into the future.

6.13.2.2 Habitat Conservation Plan

The District, other irrigation districts in the Deschutes Basin, state and federal agencies, local municipalities, and environmental groups have developed a multi-species HCP for the upper Deschutes Basin for listed species and those that may become listed during the 20- to 50-year life of the HCP: Oregon spotted frog, bull trout, Chinook salmon, steelhead salmon, and sockeye salmon.

The Final HCP was published in the *Federal Register* on November 6, 2020 (85 Fed. Reg. 71086, 2020) and a Final Decision by USFWS and NMFS was made on December 31, 2020. Covered activities include:

- Storage and release of irrigation water from:
 - Crane Prairie Reservoir
 - Wickiup Reservoir
 - Crescent Lake Reservoir
 - Prineville Reservoir
 - Ochoco Reservoir
- Diversion of irrigation water
- Conveyance and delivery of irrigation water
- Irrigation return flows
- Existing hydropower
- City of Prineville water use activities

6.13.2.3 Deschutes Basin Irrigation District Modernization

Other irrigation districts in the Deschutes Basin are working to pipe their infrastructure and would implement projects similar to those proposed by AID in this Plan-EA. Four Districts (Tumalo Irrigation District [TID], Swalley Irrigation District [SID], COID, and Ochoco Irrigation District [OID]) have authorized Plan-EAs. TID plans to pipe approximately 68.8 miles of its canals and laterals over the course of 11 years. SID plans to pipe approximately 16.6 miles of its canals and laterals over the course of 7 years. COID plans to pipe approximately 7.9 miles of its system over the course of 4 years. OID plans to pipe approximately 16.8 miles of its system over the course of 3 years. The other districts most likely to obtain necessary funding and permitting in the next 2 years are LPID and NUID. LPID and NUID have initiated the Plan-EA process, but the extent of the projects are still being determined. All of these six modernization projects are contingent on the availability of funding.

6.13.3 Cumulative Effects by Resource

Cumulative effects are considered for each resource in combination with past, present, and reasonably foreseeable future actions.

6.13.3.1 Cultural Resources

Although the canal system has undergone changes in the past (e.g., improvements between 1905 to present), the basic operations of the District would not be altered due to the proposed improvement efforts. To date, the District's conveyance system has not been evaluated for its eligibility for listing on the NRHP.

Cumulative impacts to cultural resources would occur if other past, present, or reasonably foreseeable actions or projects affect the same historic properties and/or cultural resources as the

proposed action. Cumulative impacts can result from individually minor but collectively significant actions that occur over a period of time. Where impacts to historic properties including any previously recorded, unevaluated, or not yet documented resources such as archaeological sites, architectural sites, cultural landscapes, or traditional cultural properties would be unavoidable, measures to mitigate the adverse effects would be identified in a Section 106 agreement document (e.g., memorandum of agreement, programmatic agreement). This document would be developed in consultation with the SHPO, THPO, and other consulting parties, including affiliated tribes.

Any cumulative impacts to the District's conveyance system, which is a possible historic property, by future actions such as new piping would be analyzed in light of the conveyance system NRHP eligibility status. Cumulative impacts would not be expected if the conveyance system were determined not eligible for the NRHP; however, if the conveyance system were determined to be eligible and a future action would result in adverse effects under Section 106 of the NHPA, these effects would be addressed in consultation with SHPO, THPO, and other consulting parties, including affiliated tribes, to mitigate adverse impacts. The cumulative impact analysis would consider whether the impact and proposed mitigation is adverse or beneficial for the human environment.

All other projects considered in this cumulative impact analysis would likely be required to comply with Section 106 of the NHPA, which requires federal agencies to assess and mitigate adverse effects, including cumulative effects, on historic properties/cultural resources. The District has developed a plan to address unanticipated discoveries of cultural resources and human remains during construction of the proposed action. Other federal projects would implement similar plans and measures. These cultural resource studies agreement documents and plans ensure proper documentation; protection; and avoidance, minimization, or mitigation of important cultural resources.

6.13.3.2 Land Use

The project area has been substantially altered over the past century by a variety of human activities, including agricultural development, livestock grazing, urban and suburban development, and road construction. Implementation of the proposed action would support existing land uses as recent water conservation projects have, and as would implementation of current and reasonably foreseeable future actions and additional irrigation district modernization. Therefore, together with the proposed action, these activities would cumulatively support existing agricultural land uses.

6.13.3.3 Public Safety

Past, current, and future piping projects in the Deschutes Basin all serve to improve public safety by eliminating the risk of drowning in open irrigation canals. Implementation of the proposed project would contribute to these cumulative effects by further reducing cumulative risk to public safety of open irrigation canals.

6.13.3.4 Socioeconomic Resources

Past actions, including agricultural and other land development, and recently completed projects have established the socioeconomic setting of the Deschutes Basin by supporting development and

agriculture. Current and reasonably foreseeable future actions would continue to support agriculture through improved infrastructure. Since the proposed action would also support the local economy through construction expenditures and intensified agricultural production, it would contribute to a cumulative benefit to socioeconomic resources in the area.

6.13.3.5 Soils

Past, ongoing, and future actions in the surrounding area that affect soils include agricultural uses, land development, and water management activities. The amount of soil affected by the proposed action is small compared to the area affected by other past, present, and reasonably foreseeable future actions in the area; the proposed action would therefore have a minor contribution to cumulative effects on soils.

6.13.3.6 Vegetation

Agricultural activities, livestock grazing, vegetation control along roads, and urban and suburban development are responsible for most of the past and ongoing effects on vegetation in the project area and the region. The amount of vegetation that would be affected by the proposed action is small compared to the area affected by past and ongoing agricultural activities, livestock grazing, vegetation control along roads, and other utility corridors in the area. Current and reasonably foreseeable future actions also would have relatively small effects (irrigation infrastructure piping projects in other irrigation districts) or beneficial effects (HCP) on vegetation. Ongoing effects of past actions are not expected to change measurably from current conditions, and additional effects from the proposed action would be minor, resulting in a minor contribution to cumulative effects on vegetation.

6.13.3.7 Visual Resources

The visual quality of lands in the Deschutes Basin has changed due to past and present development, and these changes are expected to continue. The impact to visual resources from the Piping Alternative would be a minor, long-term effect that would be similar in character to the existing landscape and development; therefore, combined with other actions, the cumulative effects on visual resources would be low.

6.13.3.8 Water Resources

Past actions over the last 120 years that have affected water resources include urban and agricultural development, road construction, road maintenance, and other irrigation projects. Since the early 1990s, there has been increasing interest in conserving water and restoring streamflow to the Deschutes River. The District and other Deschutes Basin irrigation districts have implemented various water conservation projects. These recent, past efforts have included piping existing irrigation canals, on-farm conservation, water management changes, and changes to crop production, which have resulted in increased streamflow in the Deschutes River (Section 4.8.3) but decreased seepage into the groundwater table (Section 4.8.5).

Ongoing and reasonably foreseeable future actions that could affect waterbodies associated with District operations include additional irrigation piping projects being considered by other Deschutes area irrigation districts that divert water from the Deschutes River (Table 6-1), on-farm water

conservation work, and HCP requirements. These actions accompanied by the proposed action would cumulatively increase streamflow in the Deschutes River and its tributaries, resulting in beneficial cumulative effects on water resources.

Table 6-1. Potential Water Conserved Instream from other Public Law 83-566 Projects¹ Approved or Proposed in the Deschutes Basin.

Irrigation District	Total Water Protected Instream (cfs)	Reach Affected ^{1, 2}
Tumalo Irrigation District	48	Approximately 30 cfs would be allocated to Tumalo Creek during the irrigation season, and 18 cfs would be allocated to Crescent Creek during the non-irrigation season. Both creeks are tributaries of the Deschutes River.
Swalley Irrigation District	15.2	The entire 15.2 cfs would be allocated to the Deschutes River from RM 164.8 to RM 120.0 during the irrigation season.
Central Oregon Irrigation District	30.3	Up to 30.3 cfs would be protected in the Deschutes River below Wickiup Reservoir (RM 226.8) during the non-irrigation season through an instream lease.

cfs = cubic feet per second; RM = River Mile

Notes:

¹The water protected instream from projects in TID, SID, and COID are from authorized Plan-EAs and are reasonably foreseeable to occur. LPID and NUID have started the Plan-EA process, but water savings are still being determined.

²Flows allocated instream during the irrigation season are shown as maximum flows and may be reduced during the shoulder season depending on the Districts' water right. Flows allocated instream during the non-irrigation season are shown as a flat rate (cfs). See each District's Plan-EA for more information regarding the timing and location of instream flows.

Reasonably foreseeable irrigation canal and lateral piping projects throughout the Deschutes Basin may contribute to a reduction in groundwater levels. On the eastern side of the Deschutes River, seepage from SID's canals most likely percolates to shallow aquifers, where it may be extracted for groundwater consumption, or ultimately discharge into the Deschutes River (Gannett et al. 2017). Because AID is up gradient in the groundwater system, its projects may affect groundwater within COID. TID's ongoing project and LPID's reasonably foreseeable project are not proximal to AID and therefore would have no effect on groundwater levels in AID. For reference, TID's project is located on the west side of the Deschutes River and LPID is located on the north side of the Crooked River (Figure 1-1). In the next 50 years, if AID, SID, and COID's irrigation piping projects are implemented fully, groundwater levels are locally expected to decline 6.8 feet.³³ In conjunction with the effects of climate variability, AID's project would have a minor cumulative effect on local groundwater levels (Section 4.8.5; Gannett and Lite 2013). The effects of local groundwater

³³ This assumes that SID's and COID's project would reduce local groundwater recharge by 6,172 acre-feet per year and 10,280 acre-feet per year, respectively.

reduction due to piping would be mitigated by increased streamflow during the non-irrigation season, some of which would likely infiltrate into the regional aquifer.

Water quality could be affected due to nonpoint source pollution such as erosion and runoff associated with ongoing and potential construction and land development activities, including the proposed irrigation piping projects. The proposed action would be constructed when there is no water in the canal system; construction practices for similar proposed projects are anticipated to be comparable. Proposed cumulative actions would contribute to water quality improvements anticipated from the reduction in erosion from the District's canals and increasing streamflow in waterbodies affected by District operations.

Implementation of the proposed action, HCP requirements, and other reasonably foreseeable future actions would have a moderate cumulative effect on water resources as implementation of irrigation piping projects could reduce groundwater infiltration, increase streamflow, and improve water quality.

6.13.3.9 Fish and Aquatic Species

Past and ongoing land uses, water diversions, and reservoir operations are responsible for most of the past and ongoing direct and indirect changes in water availability, seasonality, and access to habitat that has cumulatively affected aquatic communities and habitat in the Deschutes Basin.

Past and ongoing land use activities in the project area are not expected to change from current conditions. Future land developments and irrigation district modernization projects may cause short term and temporary effects on fish, such as sediment inputs or aquatic habitat disturbance, and could potentially affect waters within the same watershed as the proposed action. However, the ongoing and reasonably foreseeable future actions described above, including irrigation modernization activities and the HCP requirements, are all proposed for improving aquatic habitat conditions in the Deschutes Basin.

Implementation of the proposed action when combined with other future actions is anticipated to have a beneficial cumulative effect on fish, aquatic species, and available habitat for these species. Implementation of other irrigation piping projects could have an additive effect on the amount of water conserved.

6.13.3.10 Wetlands and Riparian Areas

Past actions that have affected wetlands, riparian areas, and floodplains in the Deschutes Basin include land development, agricultural activities and infrastructure, water diversions, and reservoir operations. These activities are expected to continue. Effects on wetlands from the proposed action and any effects from other current and reasonably foreseeable irrigation modernization projects would be anticipated to be localized and short term; therefore, implementation of the proposed action would not be anticipated to have a cumulative impact to wetlands in the Deschutes Basin.

Overall, improvements in streamflow that are anticipated from implementation of ongoing and future actions (Table 6-1) coupled with the proposed action would be anticipated to have a short-term³⁴ cumulative benefit and improve hydrology for riparian vegetation in the Deschutes Basin.

6.13.3.11 Wildlife

Past and ongoing land use activities including agriculture, urban, and suburban development have affected wildlife and wildlife habitat in the Deschutes Basin starting in the late 1800s. Agricultural activities have substantially altered the habitat in the region by removing native vegetation in some areas and diverting streamflow. Livestock grazing occurs in much of the region around the project area and can result in the introduction and spread of weed species, the degradation of native habitat, and trampling of riparian and wetland areas. Some native habitats have been replaced with disturbance-tolerant or introduced species assemblages that may support different wildlife than previously existed. These ongoing activities would continue to affect wildlife and wildlife habitat in the project area.

Effects on wildlife due to the implementation of the proposed action and past, current, and future irrigation modernization projects would be localized and temporary, limited to disturbance during construction and on those wildlife that use open canals as a water source. Implementation of the proposed action and other irrigation modernization projects would cause wildlife to find other water sources as they did prior to installation of the canals. Since the effects on wildlife have occurred and would occur over a period of time in which animals would be able to adapt, the cumulative effect on wildlife from the implementation of the proposed action would be minor.

In addition, vegetation control activities including herbicide applications to control noxious weeds and mechanical cutting of vegetation are ongoing actions that contribute to wildlife habitat changes. The amount of wildlife habitat that would be affected by the proposed action is small compared to the area affected by past and ongoing agricultural activities, livestock grazing, vegetation control, and urban and suburban development in the area. In addition, the intensity of these ongoing actions is not expected to change measurably in the future, resulting in minor additional cumulative effects.

6.13.3.12 Wild and Scenic Rivers

Sections of the Deschutes River have been designated as Wild and Scenic under the National Wild and Scenic Rivers Act, and a section of the Deschutes River is designated as an Oregon State Scenic Waterway. These designations aim to protect these areas from changes that generally alter the scenic, recreational, and ecological qualities of these areas. Changes to the current and future management of these river sections, which are in areas affected by District operations, are expected to be negligible. These Wild and Scenic waterways would continue to be managed by federal and state agencies consistent with their designations.

6.13.3.13 Ecosystem Services

All reasonably foreseeable actions regarding the modernization of irrigation infrastructure in the Deschutes Basin would work in concert to conserve water and improve water availability to

³⁴ These benefits would be realized until Year 8 of the HCP when target flow minimums are increased to 300 cfs.

irrigators. Past and ongoing actions described in the sections above have also contributed to water availability for irrigations and instream flow. Past, ongoing, and reasonably foreseeable actions in the Deschutes Basin could all impact ecosystem services. However, implementation of the proposed action when combined with other future actions is anticipated to have a beneficial cumulative effect on all ecosystem services assessed.

7 Consultation, Coordination, and Public Participation

The District and its partners planned and conducted numerous agency coordination and public involvement activities throughout the development of this Plan-EA. These activities included a public scoping meeting, presentation, press announcements, and frequent correspondence with federal, state, and local resource agencies, agriculture interests, and other interest groups and individuals. The project development process was designed to work collaboratively with partners, agencies, tribes, and stakeholders to ensure transparency and cooperation toward a solution that fits within the framework of the purpose and need for action.

A PIR (FCA 2018) was prepared to provide sponsors, local partners, agencies, and the public with information to evaluate the goals and objectives of the project. During the development of the PIR, project sponsors conducted initial consultation with natural resource agencies and stakeholders in the Deschutes Basin.

Public participation activities prior to release of the Draft Plan-EA included the following.

Public Announcements

- NRCS public notice (April 3, 2019)
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/pnotice/?cid=nrcseprd1450046>
- Bend Bulletin—three public notices (April 3, April 10, April 17, 2019)
- District website notice (April 3, 2019)
- Postcard to District patrons (April 3, 2019)
- NRCS news release (April 3, 2019)
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/releases/?cid=NRCSEP RD1450047>

Public Involvement Website

Information about the proposed project was added to a website to inform the public. Oregonwatershedplans.org includes the following information:

- Overview of NRCS's PL 83-566 funding program
- Overview of NEPA and EA public participation process
- Frequently Asked Questions about the EA process
- Background on the District, the Draft Plan-EA and appendices, the PIR and appendices, and presentations and handouts from public meetings
- Contact information and how to submit public comments

- Email signup option for more information; subscribers receive updates over the course of project development

Public Scoping Meeting

A public scoping meeting was held April 17, 2019, from 6:30 p.m. to 7:30 p.m. at the Elk Meadow Elementary Gymnasium, 60880 Brookwood Boulevard in Bend, Oregon. Participants had an opportunity to learn more about the proposed irrigation improvements and discuss their comments, ideas, and concerns. Public scoping comments were accepted from April 3 through May 15, 2019.

7.1 List of Persons and Agencies Consulted

Table 8-1 describes communications with agency personnel that were consulted during development of this Plan-EA. This includes agencies that provided formal or required consultation, or individuals who were conferred with and who provided substantial input. Coordination with state and local agencies has been ongoing since project inception.

Table 8-1. Agency Consultation and Communication Record.

Date	Contact, Agency	Communication
November 14, 2019	Scott McBride, USFS	Discussion of Newberry National Volcanic Monument northern boundary
November 25, 2019	Emily Weidner, USFWS	Discussion about Federally listed species, migratory birds, and bald and golden eagles in the area
February 26, 2020	Kyle Gorman, OWRD	Water rights discussion
April 6, 2020	Bridget Moran, USFWS Jennifer O'Reilly, USFWS	Discussion of Oregon Spotted Frog habitat
May 6, 2020	Bridget Tinsley, Oregon Parks and Recreation Department	Discussion about the State Scenic Waterway Corridor
June 1, 2020	Alicia Underhill, USFS Kevin Larkin, USFS Michelle King, USFS	Discussion about Wild and Scenic Section 7
October 14, 2020	Scott McBride, USFS	Discussion of the proposed project
January, 2021	Joni Cain, USFS Alicia Underhill, USFS	Discussion about land ownership along the flume
February 17, 2021	Peter Lickwar, USFWS	Discussion about potential beneficial effects on bull trout

OWRD = Oregon Water Resources Department; USFS = U.S. Forest Service; USFWS = U.S. Fish and Wildlife Service

7.2 Review of the Draft Plan-EA

[To be completed after public review of the Draft Plan-EA.]

8 Preferred Alternative

8.1 Selection and Rationale for the Preferred Alternative

NRCS has selected the Piping Alternative as the Preferred Alternative³⁵ based on its ability to meet the project purpose and need, meet the Federal Objective and Guiding Principles (NRCS 2017), and provide the most beneficial effects on environmental, social, and economic resources. The Preferred Alternative is the only alternative that meets the purpose and need, funding requirements, and NEE benefit-cost ratio requirements. The Piping Alternative is the alternative that would most maximize net economic benefits.³⁶ The District and project sponsors have agreed that the Piping Alternative is the Preferred Alternative.

Although the Piping Alternative would have minor effects on various resources, those effects would be minimized or mitigated through BMPs and other compliance measures. As a tradeoff to those effects, the Piping Alternative would permanently protect instream flows in the Deschutes River, supporting ecological resources in and along the Deschutes River system, particularly habitat and water quality resources. Additionally, as analyzed in the NEE, there would be positive economic benefits including NUID agricultural benefits, reduced O&M costs, instream flow benefits, Oregon spotted frog benefits, avoided damage from failure of the open canal and flume, reduced energy costs from patron irrigation pumping, and reduced carbon outputs. When compared to the No Action Alternative in the face of current conditions and future environmental changes, the Piping Alternative would support the health and resiliency of the ecosystem downstream of Wickiup Reservoir as well as agricultural land use within the District.

8.2 Measures to be Installed

AID would pipe 13.2 miles of its Main Canal. Pipes would range in diameter from 48 to 63 inches. The existing 1-mile-long wooden flume would be removed. Below the District's diversion, the first 450 feet of flume would be replaced by supports that would hold an elevated pipe. The new supports and pipe would be approximately the same height as the existing flume. For the remaining section of flume, the pipe would be buried.

In total, 88 turnouts would be upgraded to pressurized delivery systems. Modifications to each turnout would include a pressure relief valve, an appropriately sized tee from the mainline or lateral, a gear-actuated plug valve, a magnetic meter, a combination air and vacuum relief valve, and associated hardware and spool pipe segments (Crew 2017). Five energy dissipators would also be installed as part of the project.

More details on construction and O&M of the Preferred Alternative are in Section 5.3.2.

³⁵ The "Preferred Alternative" is defined in the National Watershed Program Handbook as, "The option and course of action that the Sponsoring Local Organization and NRCS agree best addresses the stated purpose and need" (NRCS 2014).

³⁶ Net economic benefits are benefits minus costs and are not the same as the "benefit-cost ratio."

8.3 Minimization, Avoidance, and Compensatory Mitigation Measures

Project design features and BMPs that would be applied during and after construction of the Preferred Alternative to avoid and minimize effects on environmental and social resources are described below.

8.3.1 Construction Limits and Schedule

Where possible, work would be confined within the existing ROW and easements. In addition, construction limits would be clearly flagged to preserve existing vegetation and private property. Access to residences, farms, and businesses would be maintained during construction. Construction would occur during the daytime to minimize disturbance to any landowners or other individuals in the construction area vicinity.

8.3.2 Staging, Storage, and Stockpile

Mechanized equipment and vehicles would be selected, operated, and maintained in a manner that minimizes adverse effects on the environment. Appropriate emission control devices would be required for all construction equipment. Construction staging areas would be selected and used to minimize effects on vegetation and avoid tree removal. Construction equipment and vehicles would be parked a minimum of 150 feet away from streams, wetlands, ditches, and other waterbodies at the end of each workday. Fueling and maintenance operations would be performed on a flat surface away from moving equipment and at least 150 feet away from any water source.

8.3.3 Roads and Traffic Control

Standard construction safety procedures and traffic control measures would be employed to reduce the risk of collisions between construction vehicles and other vehicles, pedestrians, or bicyclists while construction is ongoing. Lane closures on roadways would be avoided during peak travel periods where possible to reduce potential traffic delays from construction vehicles. When needed, water or other dust suppressants would be used on unpaved roads and areas of ground disturbance to minimize dust and any effects on air quality.

8.3.4 Erosion Control

Silt fencing, straw wattles, geotextile filters, straw bales, or other erosion control measures would be used to minimize soil erosion and prevent soil erosion from entering waterbodies during construction. Erosion control measures would be free of weeds and weed seeds.

8.3.5 Spill Prevention, Control, and Countermeasure

Spill kits would be located at fuel storage areas, and the construction crew would have adequate absorbent materials and containment booms on hand to enable the rapid cleanup of any spill. In times of burn bans or wildfire concerns, each crew would have a fire suppression kit.

8.3.6 Invasive Species Control

Measures would be followed to avoid introduction of invasive plants and noxious weeds into project areas. Ground disturbances would be limited to those areas necessary to safely implement the Preferred Alternative.

8.3.7 Revegetation

Areas disturbed during access or construction would be regraded to their original contours. When necessary, compacted areas such as access roads, staging, and stockpile areas would be loosened to facilitate revegetation and improved infiltration. Disturbed areas would be planted with a native seed mix appropriate to the habitat. Revegetation practices would follow NRCS's *Oregon and Washington Guide for Conservation Seedings and Plantings* (NRCS 2000). Pruning would occur entirely within the ROW and would not exceed what is required for equipment clearance.

8.3.8 Wildlife Mitigation

Construction would occur outside the primary nesting period for migratory birds of concern (April 15 through July 15) and raptors (April through July). For rare occasions where construction would occur during the primary nesting period, construction would occur outside the USFWS-approved buffer distance of any known nests. Should an active nest be found, construction would be paused and a consultation with a local USFWS biologist would occur to determine the following steps.

8.3.9 Cultural Resources Mitigation

If determined necessary, mitigation measures³⁷ to address any potential adverse effects on cultural resources would be formalized with the District, NRCS, SHPO, THPO, and affiliated tribes, as appropriate, and completed concurrent with or after construction. If archaeological resources were inadvertently discovered during construction, an Inadvertent Discovery Plan would be followed. Construction would stop near the discovery, the area would be secured and protected, a professional archaeologist would assess the discovery, consultation with SHPO, NRCS cultural resources staff, THPO, and other consulting parties including affiliated tribes and ACHP would be notified and have the opportunity to comment. Continuation of construction would occur in accordance with applicable guidance and law.

8.3.10 Water Resources Mitigation

Following the completion of each phase, AID would work with OWRD and its partners to verify and measure all water savings. More information on how AID and NUID would protect the saved water is found in Section 6.8.2. Additionally, to reduce effects on junior water right holders, AID would voluntarily reduce their maximum diversion rate and identify 120 cfs as the District's pre-project maximum diversion rate for the purposes of any water right administrative actions.

³⁷ Based upon previous mitigation measures implemented by other districts in the Deschutes Basin, if mitigation were to be required it could include, but not be limited to, actions such as working with the historic society to create a board with documentation and photos of the canal. This would be available at the District's office and on the District's website.

8.3.11 Wild and Scenic Rivers Mitigation

If determined necessary, mitigation measures to address any potential adverse effects on Wild and Scenic Rivers' resources would be identified and formalized before construction and completed concurrent with or after construction. Potential mitigation measures could include, but not be limited to, actions such as ensuring that the flume would blend into the surrounding landscape, construction would occur within the ROW, and construction staging would minimize impacts to visual resources.

8.4 Land Rights and Easements

To the extent possible, the Preferred Alternative and construction activities would be located entirely within the District's existing ROW and easements. The District's ROW was granted under the Carey Act and includes the flume and Main Canal. The District's ROW under the Carey Act extends 50 feet on each side of the canal from the toe of the bank for a total easement width of 100 feet plus the width of the canal. In places where the District has other easements separate from the Carey Act, the width of the easements is variable. Prior to construction, the District would assess the existing easements for the construction segment and work with adjacent landowners.

At this time, construction along the 0.3-mile section of the flume that crosses the Newberry National Volcanic Monument managed by the USFS is not expected to occur outside of the District's ROW. However, if closer to implementation it is determined that construction activities would occur outside of the ROW, the District would coordinate with USFS. Any work would be temporary for staging or access. The District would obtain any required permits, follow identified BMPs, and restore impacted areas to preconstruction conditions.

8.5 Permits and Compliance

8.5.1 Local and County

Deschutes County Planning: Under OAR Chapter 340, Division 18, a Land Use Compatibility Statement would be submitted for county approval prior to construction.

8.5.2 State

Department of Environmental Quality: The National Pollutant Discharge Elimination System program implemented by ODEQ would require a permit for construction activities including clearing, grading, excavation, materials or equipment staging and stocking piling that would disturb 1 or more acres of land and have the potential to discharge into a public waterbody.

Oregon Water Resources Department: To change the place of use, character of use, and/or point of diversion/appropriation of a water right, a water right transfer application must be approved by OWRD.

Department of State Lands: A wetland fill permit from ODSL would not be required for work in existing canals. Prior to initiation of construction of the project, surveys would be conducted to confirm the lack of wetlands in the project area as indicated by NWI and aerial imagery. If a wetland

is identified, however, a wetland determination and/or delineation would be conducted. Wetlands would be avoided to the extent practicable.

Oregon Fish Passage Law: Laws regarding fish passage are found in ORS 509.580 through ORS 509.910 and in OAR 635, Division 412. Functioning fish screens are present at AID’s irrigation diversion, and no fish are present within existing canals and laterals; therefore, no additional consultation or permitting is required.

8.5.3 Federal

National Historic Preservation Act Section 106: Pursuant to 36 CFR Part 800 of the NHPA (1966, as amended in 2000) and regulations of the ACHP implementing Section 106 of the NHPA (54 U.S.C. 306108), federal agencies must take into account the potential effect of an undertaking on “historic properties,” which refers to cultural resources listed in, or eligible for listing in, the NRHP. Consultation with SHPO, NRCS, THPO, and other consulting parties including affiliated tribes to fulfill Section 106 obligations would be completed for the project prior to implementation.

Clean Water Act:

- **Section 404:** Under Section 404(f)(1)(C) of the CWA, discharges of dredged or fill material associated with construction or maintenance of irrigation ditches, or the maintenance (but not construction) of drainage ditches, are not prohibited by or otherwise subject to regulation under Section 404. Discharges of dredged or fill material associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities—as are appurtenant to and functionally related to irrigation ditches—are included in the exemption for irrigation ditches. Under 33 CFR 323.4(a)(1)(iii)(C)(1)(i), “[c]onstruction and maintenance of upland (dryland) facilities such as ditching and tiling, incidental to the planting, cultivating, protecting, or harvesting of crops, involve no discharge of dredged or fill material into Waters of the United States, and as such never require a Section 404 permit.” The construction and maintenance of irrigation ditches and maintenance of drainage ditches may require the construction and/or maintenance of a farm road. Subsection 404(f)(1)(E) exemption for discharges of dredged or fill material associated with the construction or maintenance of farm roads applies where such related farm roads are constructed and maintained in accordance with BMPs. However, as stated in 33 CFR 323.4(a)(6) and 40 CFR 232.3(c)(6), there must be assurance that flow and circulation patterns and chemical and biological characteristics of Waters of the United States are not impaired, that the reach of the Waters of the United States is not reduced, and that any adverse effect on the aquatic environment would be otherwise minimized. Prior to construction activities, coordination and consultation with USACE would occur and measures taken as required to identify and mitigate impacts to potential jurisdictional wetlands and Waters of the United States.
- **Section 401:** Implemented by ODEQ, see above.

Farmland Protection Policy Act: The Farmland Protection Policy Act (7 U.S.C. 4201 *et seq.*) directs federal agencies to identify and quantify adverse impacts of federal programs on farmlands. The Act’s purpose is to minimize the number of federal programs that contribute to the unnecessary

and irreversible conversion of agricultural land to non-agricultural uses. All work would be done within existing agreements and the ROW. The project would support agricultural productivity and the intention of the Act.

Endangered Species Act: The ESA establishes a national program for the conservation of threatened and endangered species and the preservation of the ecosystems on which they depend. The ESA is administered by the USFWS for wildlife and freshwater species and by NMFS for marine and anadromous species. The ESA defines procedures for listing species, designating critical habitat for listed species, and preparing recovery plans. It also specifies prohibited actions and exceptions. Section 7 of the Act, called "Interagency Cooperation," is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. Under Section 7, federal agencies must consult with USFWS when any action the agency carries out, funds, or authorizes (such as through a permit) *may affect* a listed endangered or threatened species.

- Due to the location of bull trout populations at the very downstream end of the area affected by District operations, bull trout would not be affected by implementation of the Piping Alternative under consideration. Consequently, Section 7 consultation under the ESA as amended is not warranted for this species. Additionally, it has been determined that the project would not affect the PCEs identified for critical habitat for bull trout (70 Fed. Reg. 56211, 2005). Therefore, it has been determined by NRCS that no effects would occur to federally designated critical habitat for bull trout.
- Implementation of the Preferred Alternative may affect, but is not likely to adversely affect, the Oregon spotted frog. Informal consultation with USFWS under Section 7 of the ESA has been initiated.
- The Middle Columbia River steelhead population present in the Deschutes River is classified as a non-essential experimental population under section 10(j) of ESA and is treated as "proposed for listing" because the population is located outside of a National Wildlife Refuge System or a National Park System. Federal agencies are not required to consult with NMFS because the action alternatives are entirely beneficial and would not likely jeopardize the continued existence of the species proposed to be listed. NRCS, therefore, has determined that engagement with NMFS to obtain a conference report is not necessary (76 Fed. Reg. 28715, 2011; 81 Fed. Reg. 33416, 2016).

Magnuson Stevens Act: The Magnuson Stevens Act established requirements for including Essential Fish Habitat (EFH) descriptions in federal fishery management plans, and it requires federal agencies to consult with NMFS on activities that may adversely affect EFH (PL 104-297). EFH can include all streams, lakes, ponds, wetlands, other viable waterbodies, and most of the habitat historically accessible to salmon necessary for spawning, breeding, feeding or growth to maturity. As the project would not affect EFH, consultation under the Magnuson Stevens Act is not required.

Safe Drinking Water Act: Since the project would have no direct or indirect discharge to groundwater, permitting under the Safe Drinking Water Act is not required.

Migratory Bird Treaty Act: The MBTA implements various treaties and conventions between the United States and other countries including Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds (16 U.S.C. 703–712). Under the Act, taking, killing, or possessing migratory birds or taking, destroying, or possessing their eggs or nests is unlawful. The Act classifies most species of birds as migratory except for upland and non-native birds such as pheasant, chukar, gray partridge, house sparrow, European starling, and rock dove.

Bald and Golden Eagle Protection Act: The BGEPA prohibits anyone from “taking” bald and golden eagles (including their eggs or nests) without a permit from the Secretary of the Interior (16 U.S.C. 668–668d). A section of the project area near Horse Butte Road and Knott Road is approximately 0.6 mile and 1.9 miles, respectively, from Golden Eagle nesting areas. Because of the proximity of the project area to nesting sites, requirements of the Protection Act would be implemented appropriately.

National Wild and Scenic Rivers Act: The National Wild and Scenic Rivers Act (7 U.S.C. 1271 *et seq.*) preserves and protects certain selected free-flowing rivers of the United States that, with their immediate environments, possess outstandingly remarkably scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.

8.6 Costs

Table 8-3 presents the total project cost of \$42,759,000 for the Preferred Alternative. PL 83-566 funds would support \$27,862,000 of the total project cost, where the \$14,897,000 remainder of the cost would be contributed by other, non-federal funds. Table 8-4 itemizes the costs for each project feature and the distribution of how the costs would be shared by the sponsors and NRCS for each cost item.

- Construction costs account for all material, labor, and equipment necessary for the installation of piping associated with the Preferred Alternative. These costs were estimated based on similar installations at irrigation districts in Central Oregon. The planning construction costs are estimated using the best available information about the project without having detailed design information.
- Engineering costs were estimated as a percentage of the construction cost.
- The costs presented are planning level estimates and do not reflect final costs. Detailed designs and construction cost estimates would be completed prior to initiating the project. Final construction costs would only reflect the time and materials to perform the work.

8.7 Installation and Financing

The following subsections present further details regarding installation of and financing the Preferred Alternative.

8.7.1 Framework for Carrying out the Plan

The Preferred Alternative would be implemented in a planned sequence as discussed in Section 8.7.2. NRCS and sponsor responsibilities of the project are outlined in Section 8.7.3. No cost-shared, on-farm measures are involved with this project; therefore, the responsibilities of individual participants do not need to be discussed. No preconditions are anticipated for installing the project.

8.7.2 Planned Sequence of Installation

The District would obtain all approvals and permits for the project prior to the start of construction. The entire project would be completed over a 7-year period commencing in 2022 and ending by 2029. The District developed an appropriate construction phasing schedule that focused on sections of the system with high loss; AID also worked within engineering and funding constraints to meet District, patron, and community development needs (Table 8-2 and Figure 8-1).

Table 8-1. Construction Timeline and Installation Costs by Funding Source for the Piping Alternative, Hood River Watershed, Oregon, 2020\$.¹

Construction Phase	Construction Year	PL 83-566 Funds	Other, Non-Federal Funds	Total Construction Costs
1	0	\$5,308,000	\$1,818,000	\$7,126,000
2	1	\$10,496,000	\$3,595,000	\$14,091,000
3	3	\$4,720,000	\$1,616,000	\$6,336,000
4	4	\$4,736,000	\$1,622,000	\$6,358,000
5	5	\$2,602,000	\$6,246,000	\$8,848,000
Total Project		\$27,862,000	\$14,897,000	\$42,759,000

¹ Price Base: 2020 dollars

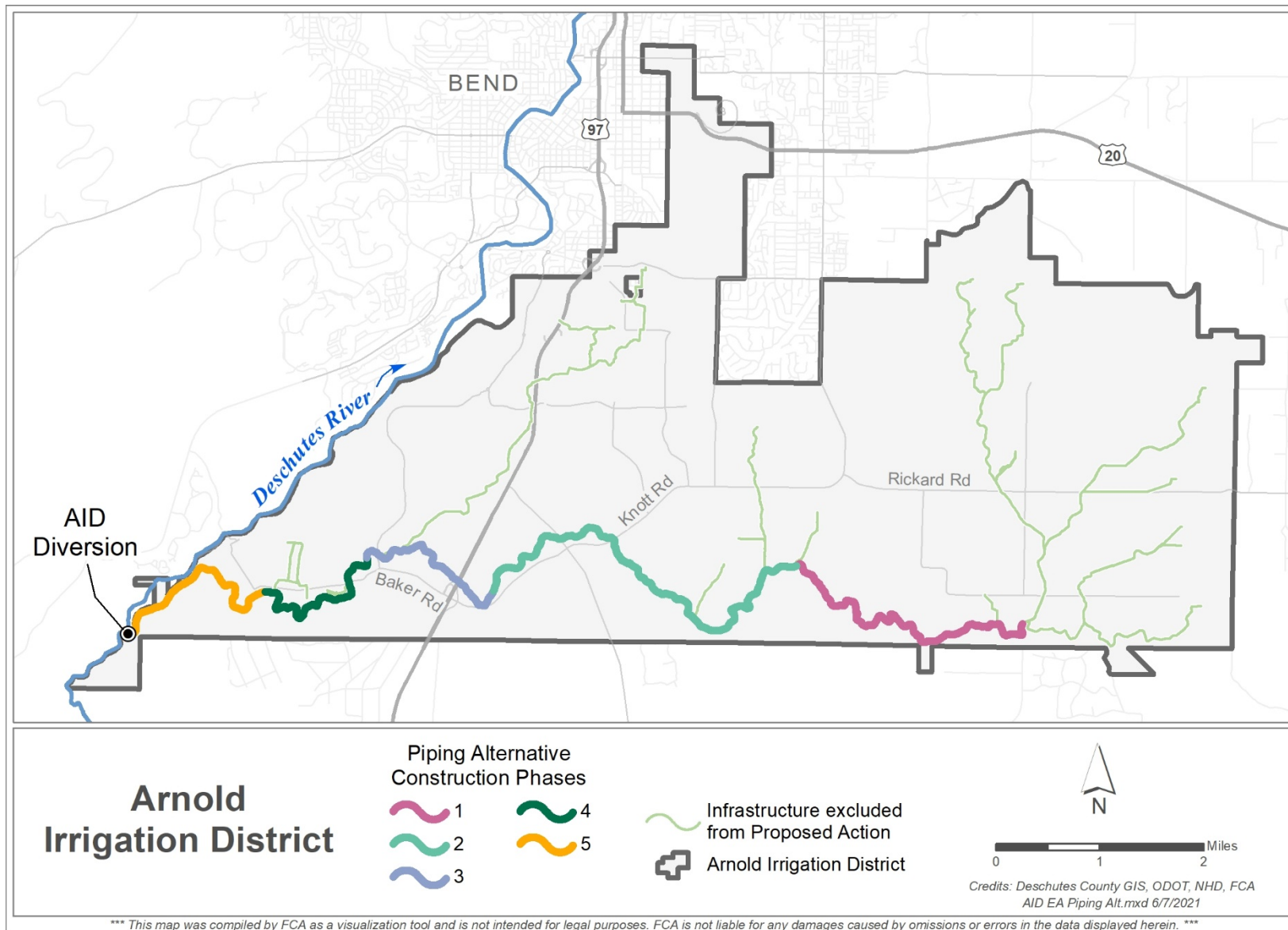


Figure 8-1. Preferred Alternative construction phase map.

8.7.3 Responsibilities

NRCS is responsible for leading the planning efforts, providing engineering design and construction oversight assistance, and certifying project completion. The District would be responsible for engineering design, project administration, environmental permitting, contracting, and construction implementation. The District has the needed authorities as an irrigation district organized under ORS 545 and has agreed to exercise those authorities to implement the actions described in this Plan-EA.

8.7.4 Contracting

Piping of the delivery system would be completed using NRCS funding mechanisms. The District would be primarily responsible for overseeing and administering project construction in coordination with NRCS.

8.7.5 Real Property and Relocations

Real property acquisition or relocations would not be required for the Preferred Alternative. All construction would be completed under either AID's existing ROW or easements.

8.7.6 Financing

NRCS would provide 65 percent of the total project cost for the Preferred Alternative through PL 83-566. The District is responsible for the remaining 35 percent of the costs, including funds that are not eligible under the National Watershed Program (project administration and technical assistance). Table 8-3 presents annual installation costs and the proportion of funding through PL 83-566 and AID.

The required match funding would be expected to be provided through a mix of grants, loans, and patron assessments. For financing, AID would apply for funding through the ODEQ Clean Water State Revolving Fund. The District expects that funding from this source would be at an interest rate of 2.5 percent, with a 0.5 percent annual fee paid on the remaining loan balance. These financing costs are not included in the NEE analysis. The District does not anticipate changing per acre annual rates or the overall base assessment fee because of any capital improvement project that is fully funded through grants.

O&M costs after project completion would be provided through the revenues of AID. O&M costs would not increase due to the project and would be budgeted on an annual basis.

NRCS reserves the authority and right to discontinue or reduce program benefits based on changes in agency priorities, funding availability, or the failure of AID to fulfill the provisions of their agreement.

8.7.7 Conditions for Providing Assistance

Conditions for the District to receive program funds for the implementation of the proposed project include completion of a Final Plan-EA, NRCS issuing a Finding of No Significant Impact, and authorization of funding by the Chief of NRCS. The Chief of NRCS acts on behalf of the Secretary of the Interior to ensure the project meets 16 U.S.C. 1005.

8.8 Operation, Maintenance, and Replacement

The District would be responsible for the O&M of the project for the extent of its design life, as well as any associated replacement costs and activities that could occur. Prior to construction, a separate O&M agreement based on NRCS's National Operation and Maintenance Manual (NRCS 2003) would be made between NRCS and the District. The agreement would continue through the design life of the project and could be modified with NRCS's approval.

Project sponsors and NRCS would make annual inspections of project measures to assure the quality of ongoing O&M. The District would be responsible for scheduling O&M inspections and for any necessary work. The District's O&M would consist of a pipe inspection program that would systematically cover inspection of the entire system over a period of several years.

The proposed system would continue its current operation schedule of April through October, in which work would be performed on an as-needed basis. During the winter months outside of the irrigation season, the District would perform system component maintenance including valve battery changes, magnetic meter maintenance, District operational valve maintenance, air and vacuum valve maintenance, pressure-reducing station filter maintenance, and valve repairs. The District would expand its current vegetation and weed management to include the areas on top of the newly piped system. All procedures would be followed as specified in the O&M agreement between the project sponsor and NRCS.

8.9 Economic and Structural Tables

A summary of the economic analysis of the Preferred Alternative (NEE Alternative) and No Action Alternative is provided in Section 5.4. The full NEE Analysis can be found in Appendix D.1. The Piping Alternative represents the future with federal funding through PL 83-566. The No Action Alternative represents the future if the District was not to receive federal funding.

Table 8-3 (NWPM 506.11, Economic Table 1) and Table 8-4 (NWPM 506.12, Economic Table 2) present the proportion of PL 83-566 funding and other funding sources. The average annual NEE costs are shown in Table 8-5 (NWPM 506.18, Economic Table 4). The costs shown are the annual costs for the Piping Alternative above the No Action Alternative, which is discussed further in the NEE in Appendix D.1.

Table 8-6 (NWPM 506.20, Economic Table 5a) presents the average annual watershed protection damage reduction benefits. The Preferred Alternative damage reduction benefits include NUID agricultural benefits, reduced O&M costs, instream flow benefits, Oregon spotted frog benefits, avoided damage from failure of the open canal and flume, reduced energy costs from patron irrigation pumping, and reduced carbon outputs.

Using the resulting benefits and costs from Table 8-4 and Table 8-5, Table 8-6 (NWPM 506.21, Economic Table 6) presents a comparison of the NEE average annual benefits and average annual costs.

Table 8-2. Economic Table 1—Estimated Installation Cost of the Piping Alternative, Water Resource Project Measures, Deschutes Watershed, Oregon, 2020\$.^{1,2}

Works of Improvement	Unit	Number			Estimated cost (dollars)						
					PL 83-566 Funds			Other Funds			Total
		Federal land	Non-Federal land	Total	Federal land NRCS	Non-Federal land NRCS ³	Total	Federal land	Non-Federal land	Total	
Piping Alternative	Feet	1,427	68,456	69,883	\$340,000	\$27,522,000	\$27,862,000	\$816,000	\$14,081,000	\$14,897,000	\$42,759,000
Total	Feet	1,427	68,456	69,883	\$340,000	\$27,522,000	\$27,862,000	\$816,000	\$14,081,000	\$14,897,000	\$42,759,000

Notes: Totals may not sum due to rounding

Prepared: January 2021

¹ Price base: 2020 dollars

² Project cost as identified in Crew (2017), updated to 2020 dollars with additional engineering considerations, project administration, and technical assistance costs based on NRCS-OR guidance.

³ Federal agency responsible for assisting in installation of works of improvement

Table 8-3. Economic Table 2 —Estimated Piping Alternative Cost Distribution, Water Resource Project Measures, Deschutes Watershed, Oregon, 2020\$.^{1,2}

Works of Improvement	Installation Costs—PL 83-566 Funds				Installation Cost—Other Funds				Total
	Construction	Engineering	Project Admin ³	Total PL 83-566	Construction	Engineering	Project Admin ³	Total Other	
Piping Alternative	\$24,900,000	\$430,000	\$2,532,000	\$27,862,000	\$13,451,000	\$143,000	\$1,303,000	\$14,897,000	\$42,759,000
Total	\$24,900,000	\$430,000	\$2,532,000	\$27,862,000	\$13,451,000	\$143,000	\$1,303,000	\$14,897,000	\$42,759,000

Notes: Totals may not sum due to rounding.

Prepared: January 2021

¹ Price base: 2020 dollars.

² Project cost as identified in Crew (2017), updated to 2020 dollars with additional project administration and technical assistance costs. Of total estimated costs, 75 percent has been allocated for construction and 25 percent for engineering.

³ Project Admin includes project administration, technical assistance costs, and permitting costs.

Table 8-4. Economic Table 4—Estimated Average Annual NEE Costs for Piping Alternative Over the No Action Alternative, Deschutes Watershed, Oregon, 2020\$.¹

Works of Improvement²	Project Outlays (Amortization of Installation Cost)	Other Direct Costs² (Increased Pumping Costs Elsewhere in Basin from Reduced GW Recharge)	Total
Piping Alternative	\$987,000	\$5,000	\$992,000
Total	\$987,000	\$5,000	\$992,000

Note: Totals may not sum due to rounding.

Prepared May 2021

¹ Price base: 2020 dollars amortized over 100 years at a discount rate of 2.5 percent.

² Other direct costs include the uncompensated economic losses due to changes in resource use or associated with installation, operation, or replacement of project structures, per PR&G guidance (U.S. Department of Agriculture 2017b). Other direct costs are presented for increased pumping costs elsewhere in the basin from reduced groundwater recharge (i.e., seepage from unlined canals) and for increased carbon emissions. This does not include operations, maintenance, and repair costs because these decline under the Piping Alternative, so these are presented as a benefit.

Table 8-5. Economic Table 5a—Estimated Average Annual Watershed Protection Damage Reduction Benefits for Piping Alternative Over the No Action Alternative, Arnold Irrigation District Watershed Plan, Deschutes Watershed, Oregon, 2020\$.¹

Item	Damage Reduction Benefit, Average Annual	
	Agricultural-related ¹	Non-Agricultural-related ¹
On-Site Damage Reduction Benefits		
NUID Reduced Agricultural Damage	\$1,489,000	\$0
Other - Reduced O&M	\$210,000	\$0
Other – Avoided Damage from Infrastructure Failure	\$17,000	\$0
Other - Pumping Cost Savings	\$4,000	\$0
Subtotal	\$1,720,000	\$0
Off-Site Damage Reduction Benefits		
Other - Social Value of Carbon (Avoided Carbon Emissions) ²	\$0	\$0
Instream Flow Value	\$0	\$42,000
Support to Oregon Spotted Frog	\$0	\$39,000
Subtotal	\$0	\$81,000
Total Quantified Benefits	\$1,720,000	\$81,000

Note: Totals may not sum due to rounding.

Prepared May 2021

¹ Price Base: 2020 dollars amortized over 100 years at a discount rate of 2.5 percent

² These benefits would also accrue to local residents, but the majority of the value would be experienced outside the proposed project area.

Table 8-6. Economic Table 6— Comparison of Average Annual NEE Costs and Benefits of the Piping Alternative Over the No Action Alternative, Arnold Irrigation District Watershed Plan, Deschutes Watershed, Oregon, 2020\$.¹

Works of Improvement	Agriculture-Related				Non-Agricultural			Average Annual Benefits	Average Annual Cost ²	Benefit-Cost Ratio
	NUID Agricultural Damage Reduction	Reduced O&M	Avoided Infrastructure Failure Damage	Patron Pumping Cost Savings	Carbon Value ³	Instream Flow Value	Oregon Spotted Frog			
Piping Alternative	\$1,489,000	\$210,000	\$17,000	\$4,000	\$0	\$42,000	\$39,000	\$1,801,000	\$992,000	1.82
Total	\$1,489,000	\$210,000	\$17,000	\$4,000	\$0	\$42,000	\$39,000	\$1,801,000	\$992,000	1.82

Note: Totals may not sum due to rounding.

Prepared May 2021

¹ Price Base: 2020 dollars amortized over 100 years at a discount rate of 2.5 percent

² From Economic Table 4

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10 List of Preparers

Under the direction of NRCS, FCA and its subcontractor Highland Economics primarily developed the Draft Watershed Plan-EA. The staff responsible for preparation of the Draft Watershed Plan-EA are included in Table 10-1.

Table 10-1. List of Preparers.

Name	Title	Education	Professional Experience	Area Responsible For
FCA Watershed Plan-EA Team				
Kristin Alligood	Program Specialist	Ph.D. Biology B.A. Neuroscience	5 years	Fish and Aquatic Species, Vegetation
Raija Bushnell	Program Specialist	M.P.A. Natural Resource Policy M.S.E.S Natural Resource Management B.A. Political Science	7 years	Land Use, Visual
Brett Golden	Program Manager	M.E.M Environmental Management A.B. Environmental and Evolutionary Biology	15 years	General
Kate Hart	Program Specialist	M.S. Earth Science B.S. Earth Science	5 years	Purpose and Need, Soils, Public Safety, Alternatives, Preferred Alternative, General
David McKay	Program Specialist	M.P.A. Environmental Policy B.A. Political Science	6 years	Cultural Resources, Public Scoping
Amanda Schroeder	Program Specialist	B.S. Natural Resource Management	6 years	Water Resources, Wetlands, Wildlife, Socioeconomics, Wild and Scenic Rivers

Name	Title	Education	Professional Experience	Area Responsible For
NRCS - Oregon				
Gary Diridoni	Natural Resource Specialist	Fisheries Management Graduate Certificate B.S. Wildlife Management B.S. Interdisciplinary Studies, Ecosystem Conservation	18 years	General
Scarlett Vallaire	Watershed Planner	M.S. Ecology B.S. Biology	12 years	General
Lakeitha Ruffin	Agricultural Economist	M.S. Agricultural Economics B.S. Agricultural Economics	9 years	Economic Analysis
Tom Makowski	Assistant State Conservationist-Watershed Resources and Planning	Ph.D. Rural Sociology M.S. Social Psychology B.S. Recreation Resource Management	31 years	General
Employees from Firms Under Contract with FCA				
Barbara Wyse	Principal and Senior Economist, Highland Economics	M.S. Environmental and Natural Resource Economics B.A. Environmental Sciences and Policy	14 years	Economic Analysis
Winston Oakley	Research Economist, Highland Economics	M.S. Applied Economics B.S. Environmental Sciences, Policy, and Management	5 years	Economic Analysis
Jason Keller	GSA Analysis	B.S. Environmental Geoscience M.S. Soil, Water, Environmental Science	19 years	Groundwater

11 Distribution List

A Notice of Availability for the Draft Plan-EA will be distributed to federal, state, and local agencies, community representatives, and area non-governmental organizations. The agencies, representatives and organizations on the mailing list include the following:

- Bend Parks and Recreation
- Business Oregon
- Central Oregon Land Watch
- City of Bend
- Coalition for the Deschutes
- Deschutes County
- Deschutes River Conservancy
- Deschutes Soil and Water Conservation District
- National Marine Fisheries Service
- Oregon Department of Agriculture
- Oregon Department of Energy
- Oregon Department of Environmental Quality
- Oregon Department of Fish and Wildlife
- Oregon Department of State Lands
- Oregon Department of Transportation
- Oregon Governor's Office
- Oregon Water Resources Department
- Oregon Watershed Enhancement Board
- State Historic Preservation Office
- Trout Unlimited
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Department of Agriculture, U.S. Forest Service, Deschutes National Forest
- U.S. Fish and Wildlife Service
- Upper Deschutes Watershed Council
- WaterWatch of Oregon

In accordance with EO 13175, Consultation and Coordination with Indian Tribal Governments, NRCS will contact CTWS regarding the availability of the Draft Plan-EA.

The names of private stakeholders and members of the public who will receive notice of the Draft Plan-EA are not listed for privacy.

12 Acronyms, Abbreviations, and Short-forms

ACHP	Advisory Council on Historic Preservation
AID	Arnold Irrigation District
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
CEQ	Council on Environmental Quality
cfs	cubic feet per second
CFR	Code of Federal Regulations
COID	Central Oregon Irrigation District
CTWS	Confederated Tribes of Warm Springs
CWA	Clean Water Act
DBBC	Deschutes Basin Board of Control District
DRW	Deschutes River Woods
EA	Environmental Assessment
EE	Environmental Evaluation
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FCA	Farmers Conservation Alliance
Fed. Reg.	<i>Federal Register</i>
HCP	Deschutes Basin Habitat Conservation Plan
IPaC	Information for Planning and Consultation
LPID	Lone Pine Irrigation District
MBTA	Migratory Bird Treaty Act
N/A	Not Applicable
NEPA	National Environmental Policy Act
NEE	National Economic Efficiency
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places

NUID	North Unit Irrigation District
NWI	National Wetland Inventory
NWPM	National Watershed Program Manual
O&M	operation and maintenance
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
OID	Ochoco Irrigation District
OM&R	operation, maintenance, and replacement
ORS	Oregon Revised Statute
ORV	Outstandingly Remarkable Value
OWRD	Oregon Water Resources Department
PCE	Primary Constituent Element
PGE	Portland General Electric
PIR	Preliminary Investigative Report
PL	Public Law
PL 83-566	Watershed Protection and Flood Prevention Program, Public Law 83-566
Plan-EA	Watershed Plan-Environmental Assessment
Project	Arnold Irrigation District Infrastructure Modernization Project
PR&G	Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies
Reclamation	United States Bureau of Reclamation
RM	River Mile
ROW	right-of-way
SHPO	State Historic Preservation Office
SID	Swalley Irrigation District
SIP	System Improvement Plan
THPO	Tribal Historic Preservation Office
TID	Tumalo Irrigation District
UGB	Urban Growth Boundary
USACE	United States Army Corps of Engineers

U.S.C.	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
U.S.	United States

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14 Appendix A-E

Appendices are provided in a separate document.

- Appendix A. Comments and Responses
- Appendix B. Project Map
- Appendix C. Supporting Maps
- Appendix D. Investigation and Analysis Report
- Appendix E. Other Supporting Information